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## **Cambodian Bamboo Market and Value Chain Study**



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## Summary

The USAID Supporting Forests and Biodiversity Project's (SFB's) aims to improve conservation and governance of the Eastern Plains (EPL) and Prey Lang Landscapes (PLL) to mitigate climate change and conserve biodiversity. In order to accomplish this ultimate goal, livelihood improvement of local communities residing within PLL is significantly important. Bamboo is considered one of the key Non Timber Forest Products (NTFPs) to boost local economic development and biodiversity conservation. The bamboo resource assessment estimated that over 100,000 culms can be harvested annually from the study sites of four villages of Kampong Kbeurng, Koh Ent Chey, Kampong Damrey and O Krasang, Boeung Char commune, Sambour district, Kratie province (Eang Hourt K., Phearom N., Piseth K., 2015), and over 50,000-100,000 culms can be harvested annually from the study areas of Kroam and Krala Peas villages, Preah Rumkel commune, Thalaborivat district, Stung Treng province (Eang Hourt K., Phearom N., Piseth K., 2015). If these resources are harvested and value is added through processing and market access, it will contribute significantly to both local economic development and biodiversity conservation. Hence, this study aims to identify potential bamboo-based products, their value chains, and what is required to improve market access to provide project management with accurate data for decision-making on design of bamboo-based livelihood activities.

Global bamboo market was expected to reach to US\$ 15-17 billion (Mekong Bamboo Consortium: MBC, 2007). Bamboo sectors in the three countries of Cambodia, Lao PDR and Vietnam was estimated to be worth to US\$ 1.2 billion per annum, and create 1.2 million jobs in 2017 (Oxfam HK 2007). In Cambodia, basket product was worth around US\$ 7 million per annum which was the main income source, but heavily reliant on Thai market (Oxfam HK, 2006). In order to accomplish the long term goal of the USAID's Supporting Forest and Biodiversity (SFB) on bamboo sectors development in the PLL, this study focuses on potential bamboo products that are relevant to the species of the SFB's target sites and their market potential, and recommends potential products for enterprise development at the target sites. A total of 52 sites located in 11 provinces and Phnom Penh capital and Aranh province of Thailand were visited. However, 7 sites located in two provinces, Kampot and Svay Rieng, are not included in this report because species used to produce basket product does not occur at the SFBs' target sites.

A total account of four bamboo species were found being traded, two wild species of *B. bambos* (Russey Roleak) and *Gigantochloa albociliata* (Russey Khley) and two domestic species of *B. blumeana* (Russey Srok) and *Thyrsostachys siamensis* (Ping Pong). *G. albociliata* is traded in raw culms for shelter frame of black pepper farms, and other two species are processed into similar product types. *T. siamensis* has thick culm wall, small hollow and straight culm, which is very important for processing into furniture. The products identified in domestic markets included raw bamboo culms, bamboo slats, incense sticks, skewers, and baskets. These products are majorly processed for domestic demand. Majority of basket products processed in Taing Bampong village, Kruos commune, Kampong Chhnang province are sold to Thailand. Many basket shops at Phsa Leu market in Thailand, close to Poipet border international checkpoint, sell all bamboo-made basket products from Kampong Chhnang. Krong Poipet has one large warehouse to store basket products for export to Thailand.

The study indicated that Sambour district in Kratie province (in particular from Boeung Char and O Kreang communes) is the main supply source of *B. bambos* to the Mekong River's downstream provinces and Phnom Penh. Whereas the supply sources to bamboo shops in Krong Kratie and Memoth district are from Chetr Borie and Snuol districts in Kratie province.

This bamboo market and value chain study covers many potential bamboo production sites and shops in order to trace the process from raw material to end markets or users. Due to time constraints, this study did not visit all the sites reported by their customers or clients.

The current annual trade of bamboos across the 45 sites of the 9 provinces and Phnom Penh capital is estimated as follows:

- 357,200 culms of *B. bambos* for bamboo slats;
- 47,008 culms of *B. blumeana* for basket, skewer and incense stick;
- 10,950 culms of *T. siamensis* (the supply capacity can reach to over 1,095,000 culms if there is market demand) for house construction and fish traps;
- 8 million culms of *G. albociliata* for shelter frame of black pepper farm.

With regard to current status of bamboo products, this study has identified a number of issues as highlighted in the followings.

- The demand for bamboo culms and bamboo slats processed from *B. bambos* has severely fallen across the study areas in 2015, which may impact the whole market chain from the primary collectors to retailers. The market decline of bamboo slats is because most of the houses used to be built by bamboos and thatches have been upgraded to wooden and concrete houses with tile roof. Though, the market of this product still exists because it is also utilized for other purposes, for instances scaffold, kiosk, floating houses, frame of concrete foundation, fishing trap, temporary building, etc.
- The current market demand of skewer and incense stick products is high at present, but most of the products are imported from Vietnam because they are made by machine with high standard and friendly use. Whereas hand-made skewers and incense sticks produced by local community from Koh Pi and Memoth districts have low quality and not friendly use, so cannot be sold in large volume. Traders of local products are now facing an issue of lack of market demand for their products.
- Baskets produced by local community from Kratie, Kampong Thom and Kampong Chhnang provinces are diverse in terms of types and sizes. Basket producers in Kampong Chhnang province produce more basket products for supply to local and international markets. The producers spend 25 days to produce baskets, and able to earn income only 3,000 riel per day. The basket producers from Kampong Thom and Kratie provinces produce similar type of basket (oval shape) for supply to their respective provincial markets. The producers of the two provinces spend 10-20 days per month to produce baskets, and able to earn daily income in between 19,500 riel and 20,900 riel per working day.

Based on these findings, a number of bamboo-based livelihood enhancement should be considered as follows:

- Bamboo culm enterprise should be considered for the four SFBs' target sites in Kratie province, market linkage from the villages to a potential trader based in Krong Kraches should be taken into account. A collection group should be formed and CF enterprise should be initiated. If CF members cannot operate the enterprise, a potential traders in the village should be identified. However, they may need financial support at the initial stage of enterprise development. Whereas the two CF sites of Preah Rumkel commune, Stung Treng province cannot rely on bamboo culm collection because of lack of market in Stung Treng province.
- Skewers and incense sticks are considered the potential semi-finished products for livelihood development, but production technology, especially invention of splitting and shredding tools should first be developed, and disseminated to local community. The state owned National Polytechnique Institute of Cambodia ([www.npic.edu.kh](http://www.npic.edu.kh)) is potential in technology development, and thus should be contacted to invent these tools. Without advancing production technology, their enterprise cannot make success. The sample incense stick should first be tested if it is workable with machine.
- CF enterprise of these two products should be initiated to link products from the processing sites to the main traders or markets. If CF enterprise group does not work, a potential trader who has experiences in business should be identified and encouraged to be an entrepreneur. The entrepreneur should be guided and provided financial support in the form of low interest rate.

- Basket product development at the enterprise scale should not be taken into account for the four target villages located in Kratie province because the transport mean in these villages is by boat, which cannot load many baskets. In addition, the transport cost by a boat is very expensive which adds a lot of cost to the products. However, basket product development should be considered for the two target CF sites of Stung Treng province because there is good road link from the villages to Stung Treng province, and to Preah Vihear, Siem Reap and Poipet. Prior making decision in this enterprise, an introduction meeting with CF members should be organized in order to assess their livelihoods, daily income and their interest in basket processing for their livelihoods and type of baskets. Resource people who have basket processing skill are listed in the annex. They should be selected based on type of products being interested by CF members. CF enterprise or a potential village trader should be established in order to link community products to the market.
- The construction of an oven to produce charcoal should be considered at the second stage in order to use bamboo residue. Bamboo waste remaining from semi-finished product and finished product processing is used to produce charcoal. Charcoal is further processed into bio char, which is environment friendly fuel for cooking.

## **1. Introduction**

The primary goal of the USAID's Supporting Forests and Biodiversity Project's (SFB's) is to improve conservation and governance of the EPL and PLL to mitigate climate change and conserve biodiversity. The project is composed of three interlinked objectives 1) build capacities of national and sub-national government officers, 2) improve dialog between forest communities and other stakeholders to solve problems that ensure conservation, and 3) ensure equitable and improved livelihoods for persons, primarily forest communities, who are living in the landscapes and committed to conserving forest resources and biodiversity.

The objective 3 is critically important in enhancing forest reliance livelihoods, and forest resource management by establishing community enterprises that will provide a sustainable source of funding to the management of Community Forests (CF) in the PLL. Likewise, to enhance community income by providing employment through value addition to bamboo products and improving market approaches to sustainable community managed bamboo resources. Additionally, properly managed wild bamboo will not only helps mitigate climate change but also contributes to habitat and wildlife protection in the PLL by offsetting local reliance on forest timber for income generation and other needs. Therefore, it is also an important component of the project to ensure that critical natural bamboo forests are protected.

In the PLL, bamboo is considered as a potential resource for enhancing local communities' livelihood. The bamboo resource assessment estimated that over 100,000 culms can be collected from the study sites of four villages of Kampong Kbeurng, Koh Ent Chey, Kampong Damrey and O Krasang, Boeung Char commune, Sambour district, Kratie province (Eang Hourt K., Phearom N., Piseth K., 2015), over 50,000-100,000 culms can be harvested from the study areas of Kroam and Krala Peas villages, Preah Rumkel commune, Thalaborivat district, Stung Treng province (Eang Hourt K., Phearom N., Piseth K., 2015). Currently, there is limited bamboo trade in raw culms at the study areas of Kratie province, and lack of bamboo trade in the two villages of Stung Treng province. The limited utilization of bamboo resources has resulted in the clearing of bamboo forests along stream banks for growing agricultural crops like cassava, rice and corn and for home gardens. This practice is contributing to soil erosion. Bamboo's dense root systems prevent soil erosion in sloping areas and/or along riverbanks, so it is important to manage this resource in the landscape.

So as to achieve the accomplishment of this project's win-win approach, this study is trying as much as possible to identify the potential bamboo-made products, their value chains and markets.

### **Objectives of bamboo market and value chain study**

The general objective of this study is to assess the value chain and market potential for particular products based on bamboo supply in order to contribute to the long term goal of viability for cottage bamboo enterprise development in PLL. The specific objectives of this study are as follows:

- 2 Identify potential bamboo products, and assess market and propose value chain linking villages to markets.
- 3 Estimate profitability by including cost of processing tools/equipment, transportation, etc.
- 4 Recommend bamboo products for livelihood development based on inventory and market analysis.

## **2. Methodology and materials**

The market and value chain study of bamboo products went through subsequent steps as follows:

- Literature review to identify what products made of what bamboo species. National and international documents were collated for this study. All products and their bamboo raw materials were listed.
- Study existing community capacity in producing bamboo products using the product scanning tool during the training workshop. This study included type of bamboo products; product size; bamboo species and other subordinate raw materials; time spent or capacity to produce one unit product; production cost; farm gate price of one unit product, and market destination of the products.
- Conduct market study of bamboo products at potential bamboo processing sites and market across the country. The study covered key points in association with products and markets as follows:
  - o product category is composed of raw materials of bamboo culms, semi-finished products, and final products;
  - o type of products, product size, materials used for processing products, and volume of raw materials being utilized for one unit product, and
  - o market and nature of commercial trade, trade route and transport mean from site to site, and value chain.
- Two types of quantitative and qualitative questionnaires in a table format were developed to gather the information from two main actors – product transporters and traders. The interview was made on an individual basis, and sometimes in group discussion at some production sites. GPS were utilized to track the trade route and market chain of each product, and photos were taken at the interview sites.

## **3. Team composition**

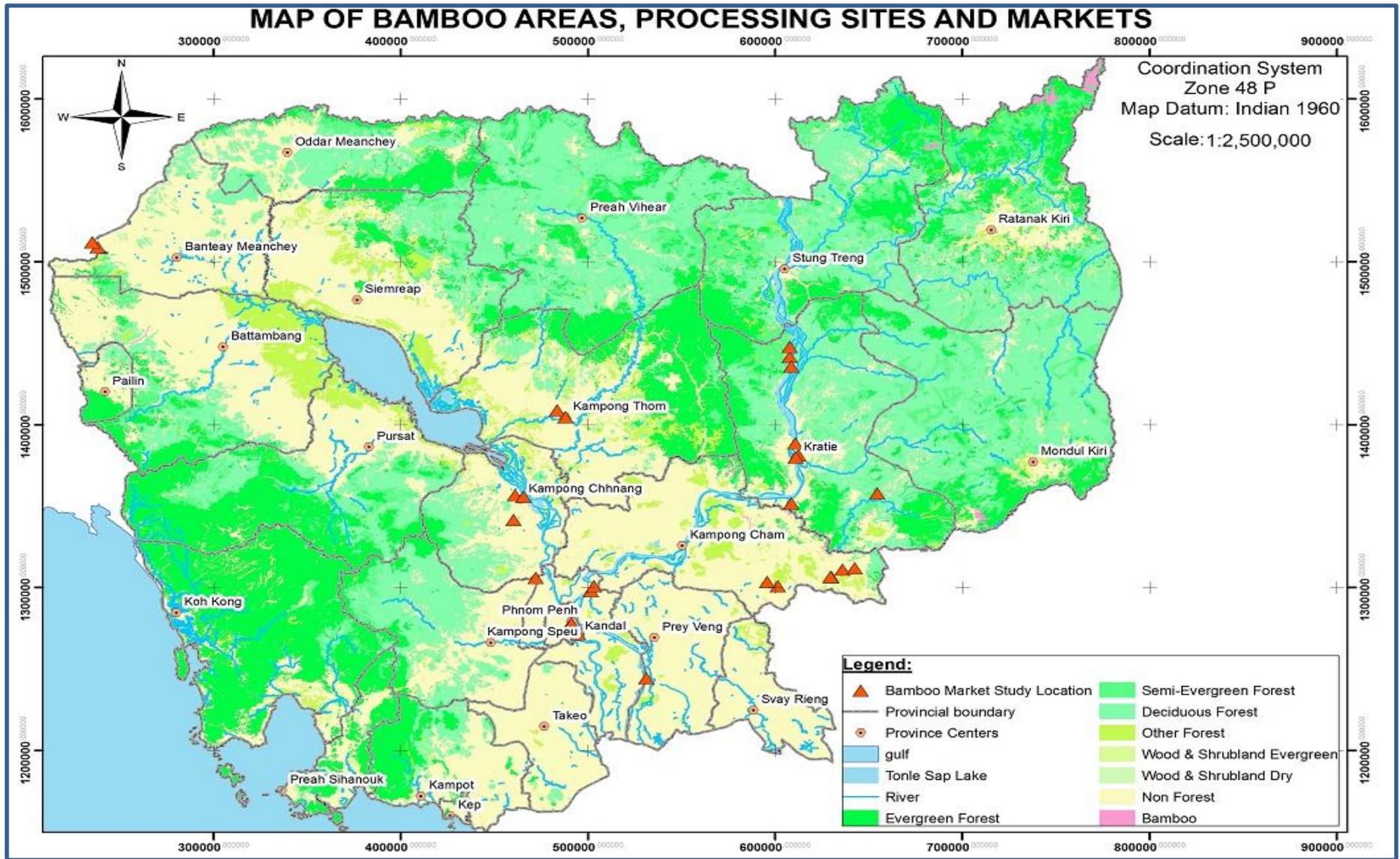
The team members included Khou Eang Hourt, Neak Phearom and Ken Piseth.

- Khou Eang Hourt, Neak Phearom and Ken Piseth interviewed local community about the use of bamboos for both traditional utilization and commercial trade, and
- Khou Eang Hourt collected field data of bamboo resources, product processing, market and value chain.

## **4. Study sites**

This bamboo market and value chain study covered many potential bamboo production sites and shops in order to trace the original supply sources to end markets or users. Due to time limited, this study cannot visit all the sites reported by their customers or clients. A total of 52 locations in 10 Cambodian provinces, Phnom Penh capital, and 1 province in Thailand (Aranh) were visited (see figure 1). However, Svay Rieng and Kampot provinces were withdrawn from the market and value chain study due to that bamboo species being used as raw material for product processing is not associated with species recorded at the SFB target sites (see annex 1).

Figure 1: Map of bamboo areas, processing sites and markets



## 5. Findings

### 5.1 Overview of bamboo products and markets

Bamboo is considered one of the most important NTFPs in Cambodia and certain ASEAN countries (Ramon, 2013). Bamboo shoots and bamboo culms have been traditionally used by forest dwellers including local Khmer people and indigenous people across the country. Bamboo shoots have been utilized either in fresh for cooking or processed into either dry or pickle bamboo shoots for use across the whole year, and sometimes for sale to markets. Bamboo culms can be made into a variety of products, ranging from very simple to complicated products with high technology: fence bar, ladder of palm trees, baskets, fish traps, house construction, mattress, chicken catches, kitchen utensil, agricultural tools, bridge, meat skewers, insect stick, chop stick, toothpick, panels, furniture, paper pulp, fiber for cloth production, etc.

Developed and developing Asian countries like Japan, China, India, Malaysia, Vietnam and Thailand produced bamboo boards and veneers from species with large culms for furniture production and house construction as substitute to timber. The followings are bamboo related studies carried out by a number of agencies:

- The scenario analysis of Mekong Bamboo Consortium concluded that the global bamboo market will reach to US\$ 15-17 Billion by 2017 (MBC, 2007).
- The world market of bamboo products in 2007, excluding bamboo pulp and raw culms, were US\$ 7 billion per annum, while market size of the three countries of Cambodia, Laos and Vietnam was US\$ 250 million p.a. (MBC, 2007).
- In Cambodia, basket products are the main income source, which is worth around US\$ 7 million per annum, but heavily reliance on Thai markets (Oxfam HK, 2006).
- It is estimated that bamboo sectors of the three Lower Mekong Countries of Cambodia, Laos and Vietnam will be worth to US\$ 1.2 billion p.a. and create 1.2 million jobs opportunity in 2017 (Oxfam HK, 2006).
- At the Bamboo Green Growth and Carbon Finance Conference that took place at Raffles Hotel, Phnom Penh in May 2012, Eric Mousset, the president of the French Cambodia Chamber of Commerce, suggested to develop the bamboo-based beam and board industry at the national level. He noted that bamboo board with special glue is harder than timber and provides superior product which could meet the worldwide demand (Phnom Penh Post, 2012).

### 5.2 Local bamboo utilization

#### 5.2.1 Potential bamboo species

The dominant wild bamboo species in the study areas in Kratie and Stung Treng provinces is *B. bambos*. Whereas two other species – *T. oliveri* and *G. albociliata*, are present in very small population and not utilized for any purpose. *B. bambos* has been substantially harvested by the local community of O Krasang village for sale to a local trader from Sambour town, while in Kampong Kboeung, Koh Ent Chey and Kampong Damrey village there are limited trading activities. There are also several cultivar varieties that local community members plant in their back yards, and farmlands. These species include *B. blumeana*, *B. vulgaris*, *Dendrocalamus asper* and *T. siamensis*. Among the domestic species, *B. blumeana* is the major species that local people plant and utilize. One household in O Krasang village plants *B. blumeana* on commercial scale on his farmland.

## 5.2.2 Traditional bamboo uses

### Population

The four villages of Boeung Char commune are composed of 334 households, whereas the two villages of Preah Rumkel commune comprise of 366 households. Rice cultivation is the main livelihood activity of the community members. Bamboos are part of key natural resources being harvested for household consumption. Trade of bamboo products was reported in only three villages of Kampong Kboeung, Koh Ent Chey and O Krasang. Table 1 summaries the population status of the study area.

**Table 1: Villages, households and population**

Villages	Number of Households	Total population	Farming and Natural resource dependent households	Bamboo dependent households
Kampong Kboeung	92	406	92	5
Koh Ent Chey	120	597	120	10
Kampong Damrey	74	335	74	0
O Krasang	48	251	44	15
Kroam	215 (178 houses)	1,319	215	0
Kralapeas	151	660	151	0

Source: Interviews with village chiefs and commune council.

### Bamboo utilization

*B. bambos* has been utilized traditionally by community, as food, fence bars, small house and cottage construction, fishing traps, thatch frames, and sometimes baskets. So far, there is lack of bamboo processing facility for commercial trade beside bamboo culm collection for sale in raw materials to traders in Kratie province.

- Bamboo shoots: bamboo shoots are a popular wild food consumed by local communities. It is cooked or processed into pickle bamboo shoots for household consumption. However, none of households in the study areas harvest bamboo shoots for commercial purpose.
- Fence bars: wooden poles and bamboo are the two main components of fences surrounding houses and farm gardens to prevent cows and buffalos from entering.
- Cottage: A majority of cottages at rice field or farmland (called Khtom Srae) are made of bamboo and the key components of such buildings including poles, walls, floors and interior parts. In average each cottage utilizes 10 bamboo culms annually.
- Thatch frame: bamboo slats are used as a frame of thatches for roof of houses and cottages. Even though tile and zinc are more popular for roofing the houses, many poor households still use thatches for roofing their houses and cottages. Most of the thatches are produced for household needs, but sometimes sold in the villages.
- Fishing traps: bamboo is a major composition of the fishing traps. There are a variety of fishing trap products and sizes. Four types of popular fishing traps produced by local community of all study areas are horizontal cylinder trap (Trou), cylindrical drum trap (Lop), funnel trap (Chann) and fishing fan (Angrut). These traps are produced for their own uses, but sometime sold within their community.
- Basket: Old people produce baskets for use in their families, but not for commercial trade. The traditional knowledge of basket processing within these community is gradually disappearing because the young generation lacks processing technique and do not want to learn this skill. Most of basket products made of both bamboo and plastic are bought from the market in town. Based on interview, there was an old man living in O Krasang village who has skill to process baskets. Another man, Mr. Hul Vet, dwelling in Koh Ent Chey village, Boeung Char commune, also has skill to produce basket. To produce one basket, he takes around 5-7 days, and the prices per unit product sold to his neighbors is between 20,000 – 25,000 riel. Whereas the price of baskets sold to end consumers at the Kraches market was between 7,000-10,000 riel.



Small house made of bamboo and thatches

### 5.2.3 Product types

Bamboos are mainly utilized for processing a number of basic products for household utilization or sometimes for sale to other villagers (see table 2). Fishing traps are the dominant products in the study areas because majority of community living in these villages rely mainly on fishing. Other basket products are rarely produced because it needs a lot of skills but cannot be sold in high price. In other words, many baskets in affordable price are available at the market. It is also traditionally used as a frame of woven thatches for roofing. Another traditional use is for house construction. All temporary houses at the rice field are made of bamboos. This type of house/cottage is fixed or replaced by new one almost every year.

**Table 2: Product sizes, time spent and raw materials**

Types of products	Bamboo species	Product size W x L x H (m)	Time spent	Use
<b>Fishing trap</b>				
Lop (Cylindrical drum trap)	<i>B. bambos</i>	1.5 x 2.5 x 1.3 m	3 days	Household use
Chann (Funnel trap)	<i>B. bambos</i>	0.5 x 1.2 x 0.6 m	2.5 days	Household use
Trou (Horizontal cylinder trap)	<i>B. bambos</i>	0.5 x 1.5 x 0.4 m	2 days	Household use
Leay	<i>B. bambos</i>	2 x 2 x 6 m	1 day	Household use
Sa yeurn	<i>B. bambos</i>	1.2 x 3 x 1.2 m	8 days	
<b>Basket</b>				
Kanh Chreng	<i>B. bambos</i>	Diameter: 0.8 m	5 days	Household use
Chang E	<i>B. bambos</i>	Diameter: 0.7 m	5 days	Household use
La-ei	<i>B. bambos</i>	Diameter: 0.4 m	5 days	Household use
<b>Construction</b>				
Farm cottage	<i>B. bambos</i>	n/a	5-10 days	Living
Fence Bar	<i>B. bambos</i>	n/a	3-7 days	Prevent from animal

## 5.2.4 Bamboo culm collection

Bamboos at the study areas of Kratie province are usually collected in the rainy season between May and November, but the peak collection month is in September. Some households collect bamboos for just 15 days, whereas others collect bamboos for 30-60 days for the whole collection season. Beside local community at the study areas, there are a lot of collectors from downstream villages and communes of Sambour district go and collect bamboo in the areas. Bamboo culms are collected in the rainy season because of easy to be transported by a raft from the upstream villages to downstream areas in Sambour district, Kratie and Phnom Penh. Some households who consist of many members collect bamboos in groups. The households who have only one member usually form a group of two to more members of different family to collect bamboos (called Krom Hun or company). Since that *B. bambos* has densely spiny-branch clump at the base to around 4 meters above the ground, and sparsely spiny branches at the upper part, and so harvesting bamboo culms is not so convenient.

They go to harvest bamboos by a boat and sometimes by ox carts. Members of the group define their roles – one person cut culms and another person pull out the culms and cut branches. Culms are cut in a variable height from close to the ground if there are less spiny branches to around 4 meters if dense branches on the ground. A long handle sickle (Khvang) is used to cut the culms. At the end of the day, members of the group carry culms to one place in order to be easy for transporting to the stream/river bank. They do not prefer to collect bamboos at the close clumps because of difficulty in pulling out the culms. The collection is made for culm sizes of 6.5 cm diameters upwards at base and 7 meter long, because traders will not buy culms smaller than 6.5 cm dia. Therefore, a lot of smaller culms are left in the clumps. The remaining parts of bamboos from cutting usually form thick clumps with many dry bamboos, which is prone to forest fire.

## 5.2.5 Mean of bamboo transport

The local primary collectors at the four villages of Boeung Char commune use ox carts and/or tillers to transport bamboo culms from the collection sites to the river or streams, and use raft made of bamboos to transport bamboo from upstream to downstream of the Mekong River. Using a raft to transport bamboo does not require any expense.

## 5.3 Current bamboo trade in raw materials

The bamboo trade in raw materials is variable by species because different species is utilized for different purposes.

### 5.3.1 Bamboo species, supply sources, and related products

Five bamboo species including two wild species of *B. bambos* (Russey Roleak) and *G. albociliata* (Russey Khley); two domestic species of *B. blumeana* (Russey Srok) and *T. siamensis* (Ping Pong), and one wild/domesticated species of *B. procera* (Russey Thngor) have been traded in raw culms. Domestic bamboos are usually harvested by the buyers, whereas wild species are collected by local communities who depend on bamboo for their livelihoods. Of the five species, *B. procera* does not occur at the study areas, so it is excluded from this study.

#### Bambusa blumeana (Russey Srok)

*B. blumeana* is identical to *B. bambos* in terms of morphology, and so can be easily confused for those who are not familiar with bamboo taxonomy. The two species can be distinguished by a number of characters as follows:

Character	<i>B. bambos</i>	<i>B. blumeana</i>
Clump and culm sizes	Smaller	Larger
Internodes length	Shorter	Longer
Spiny branches	More robust	Less robust
Cuticle on young culms	Less cuticle	More cuticle

*B. blumeana* is cultivated at home yards by many rural community across the lowland areas, surrounding the Tonle Sap Great Lake and the Mekong River, and also somewhat extending to highland area, for instances Ratanak Kiri and Mondul Kiri provinces. However, the study scope of this species is limited to only certain sample sites and link to bamboo-derived product processing. The followings are the study areas of the supply sources of *B. blumeana*.

- Kratie province: *B. blumeana* is in high demand for bamboo sticky rice baking at Thmor Kre, adjacent to Krong Kraches, basket production and special incant stick (incant stick with length of 1.5 meter long). This species has been planted along the Mekong River, at home yards, in patches on periodic flood plain areas and islands. It is commonly come across from Chhlong, Krong Kraches to Sambour districts bordering to Stung Treng province. Two communes supplying raw culms to other places are composed of:
  - Boeung Char: Koh Ent Chey, Kampong Damrey, Angkor Ent and O Krasang village, Sambour district and
  - Bos Leav: Talous village (former Roka Thom village), Chetr Borie district.
- Kampong Thom province: The supply sources of bamboo culms for basket processing in Lvea Chom village, Trapeang Russey commune, Kampong Svay district are from Boeng Andet village and Khvain Tean village.
- Kampong Chhnang province: Taing Bampong village, Cheung Kreav commune, Rolea Ba-ear district.
- Tbong Khmum province: Bei Pey village, Koh Pi commune, Tbong Khmum district, Memoth district.

#### ***Thyrsostachys siamensis* (Ping Pong)**

This species is usually planted at home yards, or rarely at the farms. It is classified as thick culm species because of thick culm wall and very small hollow. This species is good for furniture processing and house construction. It is planted in small scale by smallholders in different provinces surrounding the Tonle Sap Great Lake. It is frequently encountered in a number of provinces, including Kampong Chhnang, Pursat, Battambang, Siem Reap and Kampong Thom. Two study sites of this species were:

- Kampong Chhnang province: Svay Chrum commune, Rolea Ba-ear district.
- Kampong Thom province: Ko Koh village, Ko Koh commune, Santuk district. The study was actually conducted at Lvea Chom village, but the furniture makers reported that the supply source of this species is from Santuk district.

#### ***Gigantochloa albociliata* (Russey Khley)**

This deciduous spineless species is widespread in many lowland deciduous forest areas across the country. This species is neither utilized by local community nor collected for trade because of the dominance of *B. bambos*. However, its culms have been substantially utilized for shelters' frames of black pepper farms in Memoth district. Snuol and Chetr Borie districts of Kratie province are the main supply sources of culms for black pepper farms. Key communes supplying raw culms for black pepper farm and other uses were reported by primary collectors as follows:

- Snuol district: Khsem, Snuol and Svay Chras communes
- Chetr Borie district: Dar and Kantuot communes.



Bundles of *G. albociliata* (Russey Khley) transported from Khsuem commune to a bamboo shop at Memoth town.

### ***Bambusa bambos* (Russey Roleak)**

This species is utilized for many purposes, for instances scaffold, ladder to climb palm trees, baskets, animal cages, fishing traps, insect stick, house construction, etc. Its characters, ecology and abundance is referred to Participatory Assessment of Bamboo Resources in Stung Treng and Kratie provinces (Eang Hourt, K., Phirom N., Piseth K., 2015). Its population in Kratie and Stung Treng provinces is high, but the main supply source is from Kratie province only. The three main supply source of this species are from three key areas as follows:

- Sambour district: three key communes of Boeung Char, Kaoh Khnhaer and O Krieng supply bamboo culms to traders at Sambour town and Krong Kraches. These bamboo culms are exported to downstream provinces (Kandal, Prey Veng, Kampong Chhnang and Siem Reap) and Phnom Penh.
- Chetr Borie district: Three communes of Dar, Changkrang and Kantuot supply bamboo culms to three shops located in Sangkat O Russey, Krong Kraches.
- Snuol district: Snuol, Khsuem and Svay Chras communes mainly supply bamboo culms to shops located in O Russey, Krong Kraches and Memoth district of Tbong Khmum province.

### **5.3.2 Time and cost of bamboo collection**

This section is mainly emphasized on only wild species. A number of interview on bamboo-based income generation of bamboo collectors (see appendix 1) were carried out in order to analyze the breakeven point associated with bamboo culm collection for sale to market.

In general, time spent to collect bamboo culms involve a number of activities including:

- 1) trip from their homes to bamboo forest,
- 2) bamboo collection days in the forest,
- 3) bamboo transport from the forest to their home or depot.

Time spent to collect and the amount of culms harvested per day by a group of two people is broadly variable from 30 culms to over 100 culms depending on a number of factors as follows:

- distance from their home to the bamboo forest;
- mean of transport (on foot, motorbike, ox cart, tiller, etc.);
- how hard and fast they work in bamboo collection;
- bamboo species (spiny or spineless);
- season of bamboo collection (dry or rainy season);
- the scale of spiny branches and geography of the site in the clumps, and
- time of bamboo transport from the forest to their home or a depot.

### ***B. bambos***

A group with two members, Mr. Bat Leang and Mr. En Kheurn, living in O Krasang village, Boeung Char commune spends 16 days to collect 360 culms of *B. bambos*. A series of activities engaged in bamboo collection include.

- Leaving the houses to bamboo forest and searching for buffalos takes 2 days
- Cutting bamboos takes 10 days
- Transporting bamboo from the collection sites to their home (incl. leaving bamboo forest for home to take buffalo/cow, drive ox cart from their home to the collection site and transport) takes 4 days.

In average, his team of two members is capable to collect 35 culms per day. The farm gate price of one culm is 1,500 riel (about US\$ 0.4 based on 4,000 exchange rate). It is worth to note that a bamboo culm is sold in price of 1,500 riel if bamboo collectors take advance money from a trader, and 1,700 riel if cash is delivered on hand when received bamboos. Bamboo collectors usually take advance money from a trader prior starting bamboo collection. Based on this team, they are able to earn gross income in the amount of 525,000 riel for 16 days. A number of expenses<sup>1</sup> in association with the bamboo collection are rice and food. For 16 days in the forest, his team spent 20,000 riel (US\$ 5.00) for basic expenses, of which 15,000 riel for rice and, 5,000 riel for food (sugar, salt, fish sauce, MSG). Hence, the average net profit of each member for a period of 16 days is 252,000 riel (about 16,800 riel or US\$ 4.21 per day). Income generated by bamboo collectors is higher than labor cost sold in the village at the rate 15,000 riel per day. During the bamboo collection, they also bring with them fishing hooks and fishing net to catch fishes along the Mekong River or main tributaries for food.

A group of two people, Mr. Chem Chhan and his partner, living in Anchanh village, Dar commune, Kratie province collects *B. bambos* to sell to three shops in Kratie province and other consumers. His team spends 30 collection trips in the entire year, of which include 20 collection trips in the dry season and 10 collection trips in the rainy season (can be more based on order from the shops). The transport mean to collect bamboos and transport bamboos from the collection sites to the shops in Krong Kraches is by a tiller. In average, they spend one and half days for one trip of bamboo collection as follows:

- One day trip to collect bamboo: they leave home at 2-3 am to the bamboo forest, spend the whole day to collect bamboo, and return back home at 5-6 pm, and
- Half day round trip of bamboo transport from their village to the shop in Krong Kraches.

The team harvests 160 culms per collection day, and the price of one culm is 1,800 riel (if sold to end users, the price is 2,000 riel per culm). So, per trip of bamboo collection, they can earn up to 288,000 riel. The total expenses for bamboo collection are 81,500 riel and can be broken down as shown in table 3.

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<sup>1</sup> Wine and cigarette are also associated in expenses but not included in the cost of bamboo harvest.

**Table 3: Expense for one trip of bamboo collection in Dar commune, Chetr Borie district**

Description	Expense	Income	profit
Diesel: 13 litres (6 litres to drive to the bamboo forest, and 7 litres to drive to the bamboo shop in Kratie province). The price of diesel is 3500 riel per litre.	45,500 riel	-	-
Tiller maintenance.	10,000 riel	-	-
Food.	26,000 riel	-	-
Number of culm collected per day and unit price of one culm (160 culms x 1800 riel)		288,000 riel	-
<b>Total</b>	<b>81,500 riel</b>	<b>288,000 riel</b>	<b>206,500 riel</b>

By extracting the total expense, the net income generated from one trip of bamboo collection is 206,500 riel for their team. So, the average daily income generated from bamboo culm collection by one person is in the amount of 68,800 riel (or US\$ 17.21 based on 4,000 exchange rate).

### ***G. albociliata***

Four members of a family living in Sre Roneam village, Svay Chras commune harvest culms of this species at their own land, covering an area of two hectares. They generally collect 30 bundles per day, and one bundle consists of 15 culms. The farm gate price of one bundle is 5,000 riel. So, the daily gross income generated from bamboo collection is 150,000 riel. The traders or the owners of black pepper farms come to their houses, buy and transport by themselves. The total expenses for culm collection is 35,500 riel (see table 3). The followings are detail expenses for one trip of bamboo collection.

**Table 4: Expense for one trip of bamboo collection in Khsum commune, Snuol district**

Description	Expense	Income	Profit
Diesel for tillers (3 litres), and gasoline for a motorbike (1 litre). The price of diesel is 3,500 riel per litre and the price of gasoline is 4,000 riel per litre.	14,500 riel	-	-
Tiller maintenance.	5,000 riel	-	-
Food.	16,000 riel	-	-
Number of bundles collected daily and price per bundle (30 bundles x 5,000 riel)		150,000 riel	-
<b>Total</b>	<b>35,500 riel</b>	<b>150,000 riel</b>	<b>114,500 riel</b>

If extracted all expenses, the total net income per collection day remains 114,500 riel (or 28,625 riel per person). According to the family leader, 1,000 bundles each consisting of 15 culms can be annually harvested from his land. If so, the total annual net income from 2 hectare of land will be 3,683,333 riel (about US\$921).

### **5.3.3 Annual collection volume**

It is very hard to get the accurate data of annual collection volume of *B. bambos* due to broad geographical areas of bamboo forest and wide distribution of bamboo collectors. However, it can be estimated on a basis of figure obtaining from key bamboo traders in Kratie province, and key shops in Kratie and Memoth district of Tbong Khmum province. The annual supply of *B. bambos* from Sambour, Chetr Borie and Snuol district of Kratie province for use in raw materials and bamboo slat production is in the amount of 357,200 culms. This figure is illustrated in the followings:

- Sambour district: 300,000 culms
- Chetr Borie district: 44,000 culms
- Snuol district: 132,000 culms

### 5.3.4 Market and trade route

In general, Cambodia lacks large scale bamboo processing factory that demand for large volume of bamboo culms. Most of the product processing is carried out in small scale by households at certain areas. So, the demand of bamboo culms can be high in one area to low in another area.

#### ***B. blumeana***

The bamboo culms of *B. blumeana* are traditionally utilized for fishing traps, flooring, baskets, construction, etc. It is in high demand for sticky rice baking in Kratie province; and basket weaving in Kampong Chhnang province. The sticky rice bakers are now facing lack of culms to support the production. Hence, a lot of raw culms are transported from nearby areas around 40-50 km away of their villages. Chhlong and Sambour districts are the key areas to supply raw culms for the demand of sticky rice cake. It is worth noted that *B. bambos* has similar size to *B. blumeana* but not demanded for bamboo sticky rice cake baking because its interior culm wall lacks white papery layer.

In general, the farm gate prices of its culms are variable from 5,000 to 8,000 riel or rarely up to 10,000 riel per culm, depending on the culm sizes and areas (see table 5). However, its culms also lack market demand at areas where there is lack of product processing made of this species. The followings are farm gate prices of bamboo culms at different areas:

- O Krasang village, Boeung Char commune, Kratie province: the price of a bamboo culm is variable from 5,000 riel (US\$1.25) for large and medium culm size of 10-17 m long, 12-14 cm diameter at base and 5 cm diameter at tip, and 3,000 riel (US\$0.75) for small size culms of 10 m long, around 10 cm dia. at the base and 5 cm at the tip.
- Bos Leav commune, Kratie province: the price of bamboo culms varies from 5000-6000 riel per culm for medium size, and 8,000 riel per culm for large size.
- Ko Koh commune, Kampong Thom province: the price per culm varies depending on culm sizes - 9,000 - 10,000 riel for a large culms; 5,000 - 7,000 riel for medium culms, and 10,000 riel per 3 culms for small culms.
- Cheung Kreav commune, Kampong Chhnang province: the price per culm is variable from 5,000 riel for smaller culms up to 10,000 riel for larger culms.

Mr. Ek Than, chief of O Krasang Community Forestry, has knowledge of growing bamboo species of *B. blumeana* from vegetative part. He planted 97 clumps on one hectare of land in 2010. The intervals between clumps are 20 m x 3m apart. His family members spend 1 day a month to remove branches, and 2-3 days annually to establish fire break within the planting area to prevent fire from nearby wild fire. In 2014, he earned 5 million riel from 97 clumps. He sold smaller culms with 5-10 cm diameters to bamboo sticky rice bakers at Thmor Kre in the price of 3,000 riel per culm, and sold larger culms with 10-20 cm diameters to a bamboo trader from Sambour district. He can be a resource person to share knowledge to his community on bamboo planting technique. He can be contracted through his phone number 097 83 31 963.

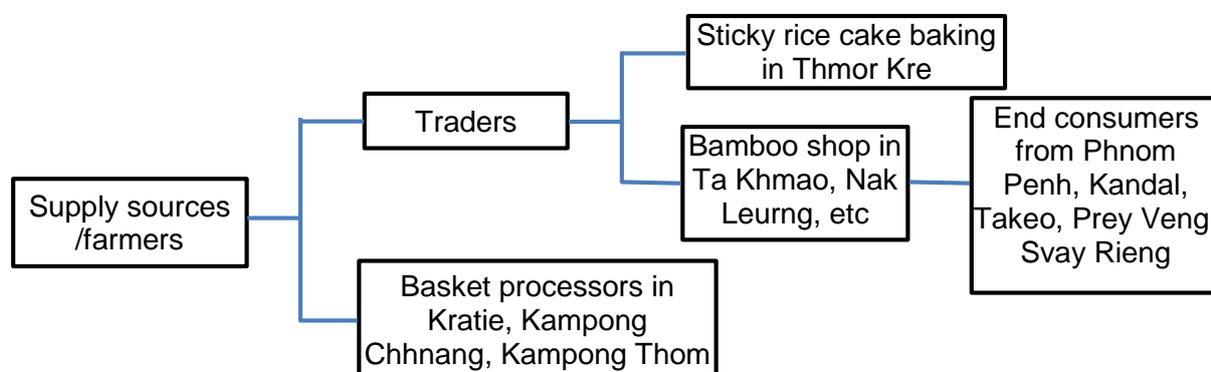
The culms are usually bought directly by product processors. The trade route of this species is usually short because of a number of factors as follows:

- Its resources at the product processing sites are fairly enough if compared to the scale of production, and so not required additional resources from other areas,
- Transport of raw culms is costly, and so add most cost to raw culms, whereas the products are in low price.

**Table 5: Summary of market and trade route of *B. blumeana* from all study sites**

Provinces	Supply sources	Buyer actors	Use purpose
Kratie	O Krasang village, Boeung Char commune, Sambour district	Bamboo trader living Samrae village of the same commune. Bamboos are transported to Phnom Penh and Neak Leung to sell to depots. Another trader buy small size culms for supply to bamboo stick rice cake bakers in Thmor Kre.	- Construction and slats for medium and large culms. - Bamboo sticky rice cake baking
	Thmor Kre commune	Bamboo sticky rice cake baker in Thmor Kre commune.	Bamboo sticky rice baking
	Talous village (former Roka Thom village), Bos Leav commune, Chet Borie district	Basket producers in Bos Leav commune. Mr. Touch Ten (071 99 17 491) and Ms. Sann Vann Sen (088 94 55 882), are two of the basket producers in this village	Basket processing
Kampong Thom	Ko Koh commune of Santuk district, Trapeang Russey commune, Salavisai commune, etc. Kampong Svay district	Basket and furniture processors in Lvea Chom village, Trapeang Russey commune Kampong Svay district, Kampong. Thom province. Mr. Huoy Yi (088 91 10 400), is the main basket and furniture producer in this village.	Basket and furniture.
Kampong Chhnang	Taing Bamptong village, Cheung Kreav commune, Rolea Ba-ear district.	Basket producers in the same commune. Ms. Nhan Thet (012 64 56 12) is one of the basket producers in the village, and Mr. So Ren (089 42 26 11) acts as either a basket producer or a village trader.	Basket.

**Figure 2: Diagram showing trade route of *B. blumeana* from the study areas**



***T. siamensis***

This domestic spineless species has thick culm wall and small hollow. It is utilized for different purposes, for instances all compositions of furniture, bamboo slats, bamboo beams, skewers, bamboo culms posted into the water for fish traps. It is largely utilized by people living

surrounding the Tonle Sap Great Lake. The farm gate price of its culms are variable by culm sizes as shown in the following table 6.

**Table 6: Price of bamboo culms at different transaction**

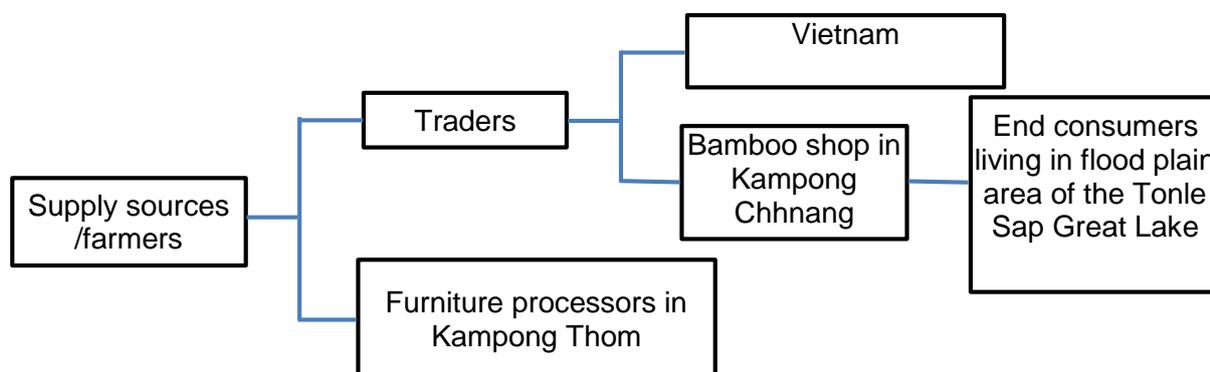
Bamboo sizes	Farm gate price	Price at the shop in Phsa Kroam	Retail price from the shop/depot
8-9 m x 5-6 cm dia. at base	3,500	4,500	5,000 -5,500 riel
8-9 m x 4-5 cm dia. at base	2,500	3,500	4,000-4,500 riel
8-9 m x 3-4 cm dia. at base	2,000	2,500	3,000 – 3500 riel

In Kampong Thom province, a furniture producer buys its culms directly at the farm located in Ko Koh commune, Santuk district, Kampong Thom province and transport to the workshops located in their village. Whereas in Kampong Chhnang province, traders buy the culms at the farm, and transport to the depots or retail shops located in Phsa Kroam of Kampong Chhnang province. This species was highly demanded at the local markets in Kampong Chhnang province in the past because of substantial use for fishing lots and temporary house construction in the flood plain area of the Tonle Sap Great Lake, but the demand has declined gradually since 2011 and sharply declined in 2014-2015. Bamboo culms will change their color from green to whitish grey if cannot be sold after around 2 weeks, and so their prices are reduced to 40% - 50% accordingly. So, if bamboo culms cannot be sold in 2 weeks onwards, the vendors will lost their profit. At present, all bamboo vendors at Phsa Kroam are facing this kind of issue. The last two year shortfall of bamboo market in Kampong Chhnang province has resulted in given up bamboo business of some 10 out of 20 vendors. The followings are the estimation of total bamboo quantity daily sold from all depots/shops located at Chong Koh from 2010 through 2015.

- In 2010, 3,000 culms are sold per day
- In 2011, 2000 culms are sold per day
- In 2012, 1500 culms are sold per day
- In 2013, 1200 culms are sold per day
- In 2014, 100 culms are sold per day
- In 2015, 30 culms are sold per day

Anecdotal report said that its culms have recently been bought and transported to Vietnam, but not known the use purpose. According to culm thickness and quality, this species seems to be good for toothpicks, chopsticks and meat skewers.

**Figure 3: Diagram showing trade route of *T. siamensis* at the study areas**



***G. albociliata***

Shelter is needed to shade the black pepper plant when it is young, and culms of *G. albociliata* are used for shelter frame. So, when more farms are developed, the higher volume of its culms for shelter frame is demanded. Shelter is removed when black pepper plants reach to 3 years old because they need sunlight to survive. At present, most of farmers move to cultivate black

pepper because of high market demand with high price. Culms of *G. albociliata* are cut year round, but the peak harvest months are between March and May. At present, Khsuem commune of Snuol district, and Svay Chras commune of Chetr Borie district are the main supply sources of bamboo culms to black pepper farmers in Tbong Khmum provinces. Since March, 10 Yi Doup trucks and 15 seat vans transport bamboo culms from these two communes to Memoth districts of Tbong Khmum province, and other places. A one 20 ton truck (Yi Doup) has a capacity to load 700 bundles, and a 15 seat van is capable to load 100 bundles. Based on current trade, about 8 million culms of *G. albociliata* are used for shelter frame of black pepper farm in Tbong Khmum (as shown in table 7).

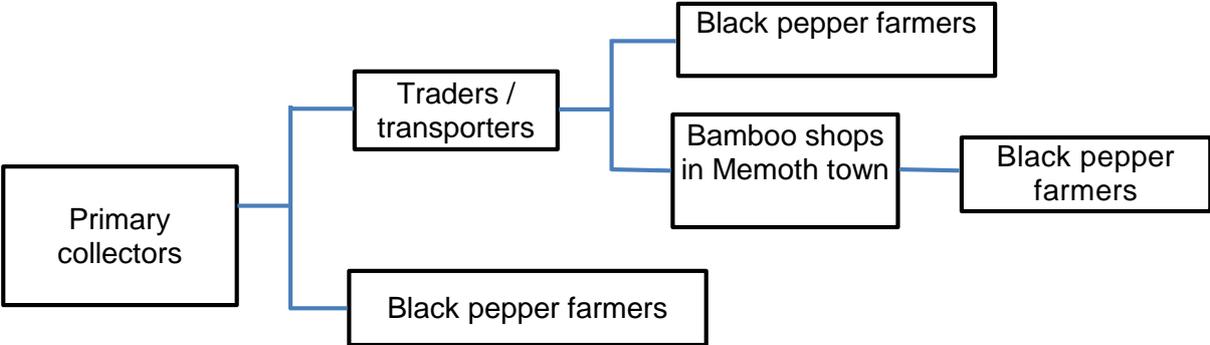
**Table 7: Number of culms transported from Khsuem and Svay Chras communes**

# vehicle per day	# bundle / vehicle	# culms per bundle	# trips per day	Number of days per year	Subtotal
Yi Doup (20 ton truck)	700	15	10	60	6,300,000
Van (15 seat)	100	15	15	60	1,350,000
<b>Total of culms</b>					<b>7,650,000</b>

The followings are the differences of price by transaction:

- Farm gate price at Sre Roneam village of Svay Chras commune is 5,000 riel per bundle of 15 culms (the culm size is around 5 meter long, 2-3 cm diameter at base).
- The price bought by owners of bamboo shops/small depots in Memoth town is 8,000 – 9,000 riel. The van drivers buy bamboo culms from the village and transport directly to the shops in Memoth town.
- The price sold out from the bamboo shops at Memoth is 10,000 – 12,000 riel per bundle.

**Figure 4: Diagram showing trade route of *G. albociliata* in Memoth district**



**B. bambos**

Kratie province is the main supply source of *B. bambos* to downstream provinces of the Mekong River and Phnom Penh capital. There are 17 bamboo depots (see table 8) randomly located along the Mekong River downstream, all of which buy bamboo culms from main traders based in Kratie province.

**Table 8: Main bamboo depots along the Mekong River**

Depot locations	Number of depots/shops	Province/capital
Prek Anchanh	1	Kandal
Dei Eth	3	Kandal
Neak Leurng	2	Prey Veng
Preah Prashop	1	Kandal
Prek Po	2	Kandal
Chak Angre Kroam	8	Phnom Penh

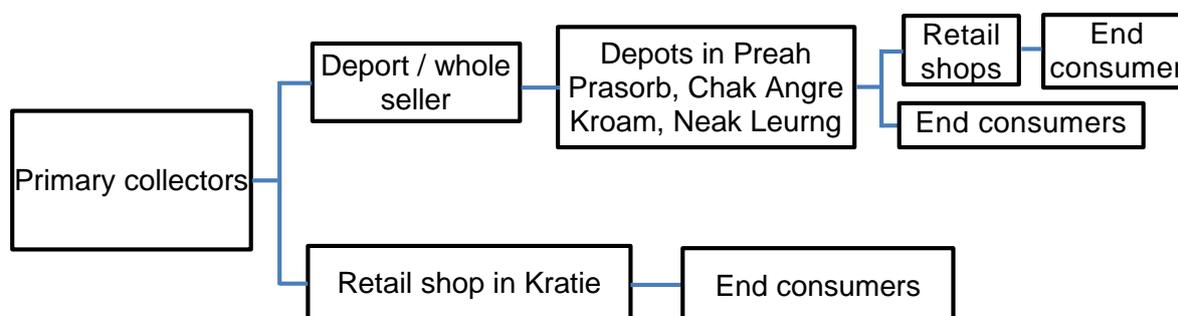
The followings are the price of bamboo culms at different transaction points:

- Farm gate price of this species at the collection sites in Boeung Char commune is 1,500 -1,700 riel per culm,
- The price sold to a depot located in Thmor Kre is 2,700 riel per culm,
- The price sold to depots in Chak Angre Kroam is 4,700 riel per culm,
- The retail price sold to end consumers in Phnom Penh is 6,000 riel per culm, including transport service.

There are three retail shops located in Kratie province. These shops get license from the government to sell sawn wood, culms and bamboos. The supply sources of bamboo to their shops are from Korsang village of Changkrang commune and Anchanh village of Dar commune, both of which are located in Chetr Borie district. The three shops together sell raw culms in the amount of around 10,000 culms per year. Most of the culms are bought for scaffolding of the concrete houses. The followings are prices of bamboo culms sold to retail depots in Kratie province:

- The price sold to the shops is 1,800 riel per culm. Collectors cut bamboo culms and transport directly to the shops
- The price sold from the shops to end consumers is 3,000 riel per culm.

**Figure 5: Diagram showing trade route of *B. bambos* at the study areas**



### 5.3.5 Means and cost of transport

Transport means are variable dependent on location, distance and volume.

- Ox cart is used in small scale by bamboo collectors in O Krasang village. There is no report on the use of ox cart in other areas.
- Tiller is mainly used to transport bamboo from the collection sites to the village, and also used to transport bamboos from the villages/forest to a depot/shop or workshop place. The tiller is usually used by bamboo collectors or small scale processors.
- Van is commonly used to transport bamboo from collection sites or villages to depots in longer distances. Vans are commonly used to transport bamboos from Khsuem and Svay Chras to Memoth bamboo shops, and transport bamboos from shops in Kratie to other provinces like Prey Veng, Stung Treng, Tbong Khmum and Kandal provinces.
- Truck (20 ton truck or Yi Doup) is used to transport bamboos in large volume, especially *G. albociliata* from villages to the shops or black pepper farm.

- Raft is commonly used for villages/communes located along the Mekong River. It is chiefly used to transport bamboos from Kratie province to provinces located downstream of the Mekong River. Raft is the cheapest transport mean, and commonly used by potential traders in Kratie province.

### 5.3.6 Consumers and uses of bamboo culms

Bamboo culms are used for many purposes depending on the species. *G. albociliata* is chiefly used for shelter frame of black pepper farm. Culms of *B. bambos* and *B. blumeana* are bought mainly for house construction, floating houses in the Tonle Sap Great Lake, processed into baskets, scaffolding and split into bamboo slats for frame of concrete foundation. *T. siamensis* is good for furniture production, and can be processed into different compositions of the furniture like floor and frame. *T. siamensis* is also mainly utilized for construction.



Bamboo shop at O Russey, Krong Kraches, Kratie province

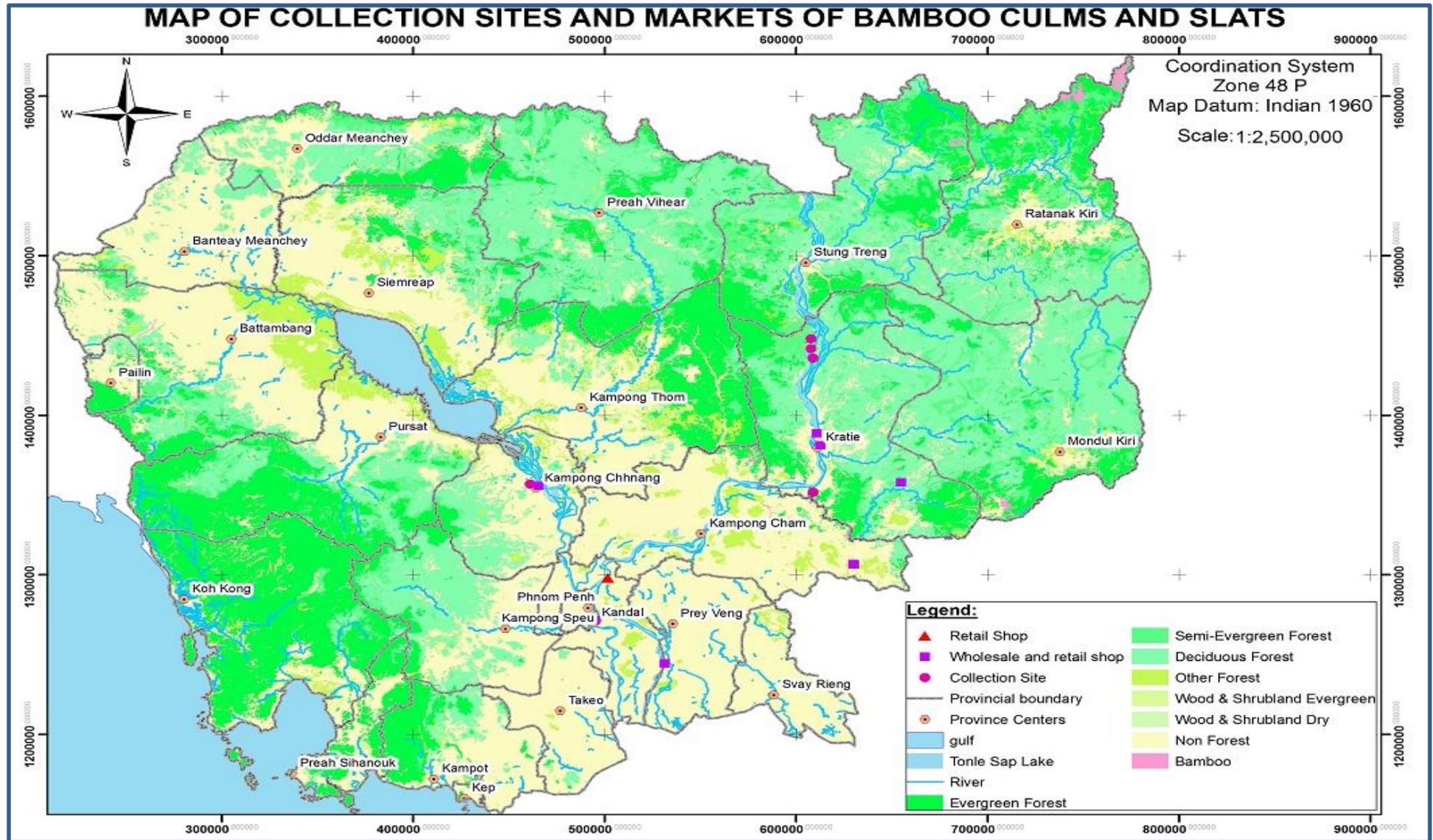


Bamboo depot in the Mekong River, Chak Angre Kroam, Phnom Penh



Bamboo depot at Chong Koh, Phsar Kroam, Kampong Chhnang province

Figure 6: Map of collection sites and markets of bamboo culms and slats



## 5.4 Current bamboo trade in semi-finished product

Semi-finished product is a product that has not been completely assembled, and so needed to be further processed into a final product. At present, the semi-finished products being identified during the course of this study are bamboo slats, incent sticks and meat skewers.

### 5.4.1 Bamboo species and supply sources

Three bamboo species including *B. blumeana*, *B. bambos* and *B. procera* are very potential for semi-finished product processing. However, *B. procera* does not occur within the study area, and so it is removed from this study.

- *B. bambos* is widely used for the processing of bamboo slats and incent stick. The main supply sources of this species are from a number of communes, including Khsuem, Dar, Changkrang and Boeung Char communes. In addition, it is collected within Kantuot and Sla and along O Chhlong for incent stick production.
- *B. blumeana* is one of the key species for meat skewer production by local community in the four villages of Chuo Kandal, Koh Chreng, Koh BeiBi and Koh Mnuong of Koh Pi commune.

### 5.4.2 Product types and time

There are three main semi-finished product types that are produced in Cambodia at present. These product types are shown in the followings:

#### Bamboo slats

Bamboo slat is the dominant bamboo semi-finished product in Kratie and Phnom Penh. A bamboo culm is longitudinally split into pieces by a machete and an installed wooden pole. Bamboo slats are mainly produced from *B. bambos*, and rarely from *B. blumeana*. The width of bamboo slats is 4 cm wide, but the lengths are variable from 2.5 to 6 metre long dependent on the need of consumers. However, most of the bamboo slats are 5 m long. The number of bamboo slats being produced per culm depends on diameter of bamboo culms as shown in the table 9.

**Table 9: Number of slat pieces vs diameter of bamboo culms**

Bamboo diameter at base	Number of pieces
9 cm	9 pieces
7 cm	6 pieces
6 cm	5 pieces
5 cm	4 pieces
4 cm	3 pieces

Few households living in Anchanh village produce bamboo slats for sale. The size of bamboo slats is 4 cm wide and 5 metre long. A bundle of bamboo slats consists of 40 pieces. In average, a group of two people produce 160 pieces, which require 32 bamboo culms.

In Sre Roneam village of Svay Chras commune, a group of people has a capacity to produce 5 bundles of slats, each of which consists of 30 pieces. So, a total of 30 culms are needed to produce 5 bundles. They spend the whole morning to cut bamboo culms, and the whole afternoon to process into bamboo slats.

Bamboo slats are also commonly produced at the depots in Chak Angre Kroam, Preah Prasorb and Neak Leurng. One culm is split into 6 pieces of slats, and one slat is 5 meter long, and 4 cm wide. Workers are employed to do the task on the condition that one meter of a bundle containing 17 slats is paid 300 riel. One person is able to produce 340 pieces of slats from about 67 bamboo culms. So, 20 bundles each consists of 17 pieces of slats and 5 meter long are produced per day. In average, one worker can earn 30,000 riel per day. The price of a

bundle of slats with 17 pieces and 5 meter long including transport service to the destination is 12,500 riel (2500 riel/1 meter of a bundle with 17 pieces).



Bamboo slats loaded in the car at Sre Roneam village, Khsum commune, Kratie province

### **Incense stick**

Incense stick is made by two main *Bambusa* species including *B. bambos* and *B. procera*. It can also be produced from *B. blumeana* but the culm price of this species is high, so hard to be generated profit. A bamboo culm is cut into incense stick size, split into flat and thin piece, and further manually split into small pieces in square shape. Memoth is the main incense stick production district in Cambodia and followed by Keo Seima district of Monulhiri province. Incense sticks consist of four types of lengths, including 25 cm long, 30 cm long, 33 cm long and 38 cm long. Among these sizes, the 33 cm long incense stick is commonly produced by community. There are around 60 percent of the 200 households in Kantuot village producing incense sticks. Most of the households spend four months (August to October) per year to produce incense sticks. In average, they make 6 collection trips per month, and each trip can harvest 10 culms (see table 10 for summary). In average, 28,800 bamboo culms are harvested to supply to incense stick production in this village, and 115.2 tons of incense sticks are produced annually (see table 10).



Incense stick product at Kantuot village, Memoth district, Tbong Khmum province

**Table 10: Volume of incense stick production**

Production activities	Production volume
Number of households producing incense sticks (60% of 200 households).	120 households
Number of months producing incense sticks.	4 months
Number of trips per month to collect bamboo culms for incense stick processing.	6 times per month
Number of bamboo culms collected per trip.	10 culms
Number of incense sticks produced per 10 culms.	40 kg
Annual incense stick production.	115.2 tons (5,760 bundles)
Farm gate price of incense sticks per bundle	30,000 riel (172,800,000 riel for the whole village)

In order to produce 40 kg of incense sticks, a couple of a household spends 4.5 days. Table 11 shows time spent and expenses by production chain.

**Table 11: Number of days required to produce 20 kg of incense sticks**

Production chain	Time spent	Expense
Harvest bamboos in the forest – 5 culms.	0.5 day	23,500 riel ( 13500 riel for 3 liter of gasoline and 1,0000 riel for food)
Cut bamboos into pieces of 33 cm long (do it in the collection sites), put them in a rice sack (2 rice sacks) and transport back home.	0.5 day	
Split into pieces and stick making.	3 days	12,000 riel per day.
Dry the sticks (It takes 2 days, but be able to do other works during the drying process, so not included in the time spent).	1 hour	
Eliminate fibre attaching on the sticks by fire.	2 hours	
Tie them into a bundle.	1 hour	
Total	4.5 days	35,500 riel

## Skewers

The skewers are made in four villages of Chuo Kandal, Koh Kreng, Koh Beipi and Koh Manuong, located in Koh Pi commune, Tbong Khmum district (former Kroch Chhma district), Tbong Khmum province (former Kampong Cham province). The skewers are made of *B. blumeana* that is planted in the village. It is in square shape with sharp point. Producing skewers is a supplementary livelihood activity following farming (tobacco, corn, soy bean and fruit trees) but it plays an important role in their daily lives because it generates daily income to expense for food and their children to go to school. There are four types of skewers, including fruit/banana/fish skewer, beef/meat skewer, chicken knee skewer and ice cream skewer. However, ice cream and chicken knee skewers are no longer produced due to that the ice cream producers use skewers made in Vietnam, and chicken knees are no longer sold in the market.

The producers buy bamboo culms in the villages. The price of bamboo culms varies from 3,000 to 5,000 riel depending on the culm sizes. A bamboo culm which is bought 4,000 riel is processed into two main product types – meat skewer and banana fruit/fish skewers. One culm is taken one whole day to process into skewers if there are 3-5 people working full time, or 3-4 days if worked part times (work during free time in the afternoon or evening). Table 12 details the volume of skewers processed from a bamboo culm and farm gate price of the products.

**Table 12: Production volumes and farm gate price of a bamboo culm**

Type of product	Size (length x width)	Size and quantity of a bundle			Production quantity	Farm gate price per large bundle
		Bundle number	Piece number	Weight (kg)		
Meat/beef skewer	15 cm x 3 mm	One large bundle consists of 10 small bundle	700	0.23 kg	13 large bundles	600 riel
Banana fruit/fish skewer	20 cm x 5 mm	One large bundles consists of 5 small bundles	350	0.50 kg	3 large bundles	900 riel

### 5.4.3 Annual production volume

#### Bamboo slat

The volumes of bamboo slats at different shops are very variable by months. Based on three main bamboo slat locations in Krong Kraches, Memoth district town, and Chak Angre Kroam, The volume of bamboo slat demand has been decreased from year to year. However, accurate data could not be obtained from the shop/depot owners because they did not remembers the figure sold by months, and seem to hesitate to share kind of information. Some traders provided average volume of bundles sold annually, whereas other traders provide lump sum figure of annual sale. The table 13 shows information provided by the traders at different locations on the sale volume of bamboo slats in 2014.

**Table 13: Annual sale of bamboo slates by shops at different locations**

Location of shop	Number of shops	Sale quantity
Krong Kraches	2	5,100 bundles
Memoth	3	3,080 bundles
Chak Angre Kraom	2	28,824 bundles
Neak Leurng	1	3,000 bundles

## Incense stick

The volume of incense stick production has currently been declined because the demand of local made incense sticks is declined. In 2014, around 1,500 bundles of incense sticks were sold by three traders located in Kantuot village, and approximate 2,000 bundles were sold by a trader in Sla village. With 20 kg per bundle, all incense sticks together are account for 70 tons. In average, a culm of *B. bambos* produces 4 kg of incense sticks, so 17,500 culms are needed for the total product volumes. An incense processing factory based in Phnom Penh demands 10 tons of incense stick per month, so both incense stick production sites are able to supply only seven months.

## Skewers

The largest whole sellers of skewers are located at O Russey market, Phnom Penh. In 2014, 500 rice sacks of skewers were reported to be sold to the shops at the O Russey market. One rice sack contains 160 bundles of beef skewers or 105 bundles of banana fruit/fish skewers, which is equal to 4 bamboo culms. So, 2,000 bamboo culms of *B. blumeana* are monthly needed for the skewer production. However, machine-made skewers in Vietnam are flowing to markets in Cambodia in recent years, and so has resulted in dramatic decline of locally hand-made skewer demand. Based on interview at the O Russey market in Phnom Penh, 83.53 tonnes of skewer have been sold annually by 5 vendors. Of which, 75.177 tonnes (or 90%) have been imported from Vietnam. The result showed that the demand of skewers made in Vietnam is higher because it has round shape with sharp point and absence of fibre, whereas hand-made skewers produced by local community in Tbong Khmum are in flat shape with no sharp points and contain a lot of fibre that are not friendly used.

### 5.4.4 Market and trade route

#### Bamboo slats

Bamboo shops located in Krong Kraches, Memoth and Prek Tamak buy bamboo slats from the primary producers, whereas depots at Chak Angre Kroam buy bamboo culms, and split at their depots for sale to customers. Bamboo slat study of the five locations has shown that the slat quantity of a bundle and the prices is variable depending on locations (see table 14).

**Table 14: Size of bamboo bundle and prices at different locations**

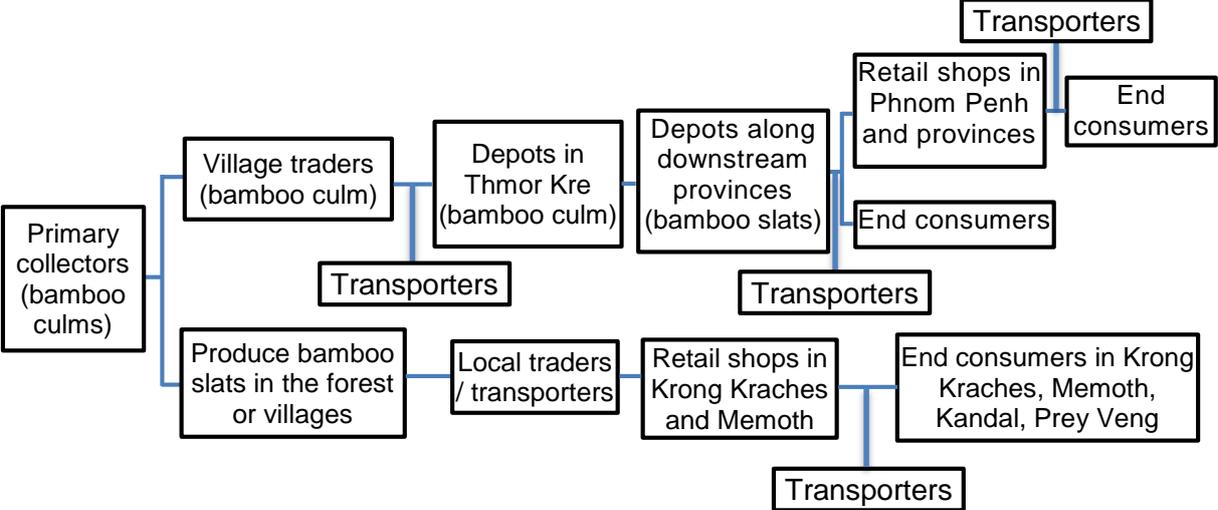
Shop locations of bamboo slats	Bundle size and length	Supply source	Purchasing price/bundle	Selling price/bundle
Krong Kraches	40 pieces x 5 m long	Anchanh village, Dar commune, Chetr Borie district	11,000 (plus cost of transport 1,000 riel)	13,000 – 15,000 riel (extract 1,000 riel)
Sre Roneam village	30 pieces x 6 m	O Preah, bordering to Mondulkiri province	10,000 riel	13,000 riel
Masin Toek village, Tromoung commune, Memoth town	30 pieces x 6 m long	Snuol, Khsum (Sre Roneam village), Svay Chras, commune, Snuol district	18,000 - 20,000 riel	22,000 - 25,000 riel
	50 pieces x 8 m long		100,000 – 110,000 riel	120,000 riel
	30 pieces x 3 m long		13,000 riel	15,000 riel
Prek Tamaik	50 pieces x 5 m long	Preah Prasorb	12,500 riel	17,000 riel
Chak Angre Kroam	17 pieces x 5 m long	Thmor Kre	Bamboo culm	12,500 riel
Neak Leung Keurt, Prey Veng	40 pieces x 5 m long	Thmor Kre	Bamboo culm	15,000 riel

The retail shops of bamboo slats located in Krong Kraches buy bamboo slats from the primary producers at Dar commune who are also the bamboo collectors, and hire tillers to transport bamboo slats from the village to the shops at the cost of 1,000 riel per bundle. The selling price at the shop is 13,000 riel if wholesale, or 14,000 - 15,000 riel if retailed. A village trader in Sre Roneam village of Khsuem commune buy bamboo slats at the processing site in the forest at the price of 10,000 riel per bundle, and transport to the village. One tiller is able to load 30 bundles, and 10 litres of gasoline (5000 riel/litre) is spent for one round trips. The price sold at her house in the village is 13,000 riel per bundle. The retail shops located at Memoth town buy bamboo slats from a village trader at Khsuem commune, and sometimes from transporters.

Mrs. Sok Kheang, a bamboo vendor, has operated her bamboo business since 1995. She has a bamboo shop located in Tromoung commune, Memoth town. She said that bamboo slats were sold in large quantity in the past, but the sale volume has fallen in recent years. She added that 2,000 bundles of bamboo slats were sold in 2014, which represented only 20% of the previous years. The demand of bamboo slats has continued to decline in 2015. She said “I would not be able to support my children to study at the university if the bamboo market was down as today”. She has noticed that the main cause resulted in the decline of bamboo slat market is because most of the houses have been replaced by wooden and concrete houses. She added that most of children of the poor families in this commune have migrated in search for job, and brought money back home. This money is used to upgrade their houses from houses with bamboos and thatches to wooden and concrete houses. She added that most of the bamboo slats are currently bought for Kiosk and frame of concrete foundation. She said if the sale of bamboo slats continues to decline, she will stop this business, and invest more time to black pepper farm. All of the bamboo traders who were interviewed shared the same opinion on the decline of bamboo slats.  
 She can be accessed through her phone number 092 20 65 09

Bamboo slats shops located in these two locations supply their products within their areas, and sometimes to other provinces, for instances Stung Treng, Prey Veng and Kandal. Whereas depots at Chak Angre Kroam buy bamboo culms transported by rafts, and process into bamboo slats for retail construction shops and end consumers in Phnom Penh, Kandal and Takeo provinces. Transport services are associated at certain transactions, especially from the depot/retail shops to another retail shops and end consumers. The fee for transporting the products is usually paid by the shop owners if in short distance, or paid by buyers if in long distance.

**Figure 7: Trade route of bamboo slats**



All vendors of the five locations reported that the demand of bamboo slats has dramatically been declined in 2015 because most of the bamboo-built houses have been replaced by

wooden and/or concrete houses. There has been minor use for frame of concrete foundation, animal cages and kiosks. Accurate sale data could not be obtained from the shop/depot owners because they did not remember the figure sold by months, and seem to hesitate to share kind of information. Some traders provide average volume of bundle sold annually, whereas other traders provide lump sum figure of annual sale.

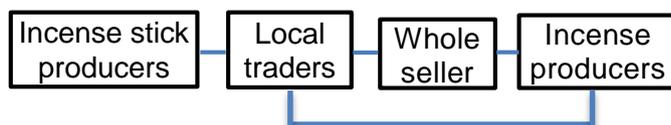
### Incense stick

Incense sticks are 33 cm long, and cross section of an incense stick bundle is 40 cm dia. A bundle is measured by using a string with 126 cm long to embrace around the bundle. A bundle is 20 kg. There are two trading villages as follows:

- Kantuot village, Choim Tamao commune is composed of three traders in Kantuot village who buy incense sticks from producers within their village, and
- Sla village, Tromoung commune consists of only one trader who buys incense sticks from producers within his village, Keo Seima<sup>2</sup> and Snuol district.

Local traders buy incense sticks from the producers and usually sell to incense producers directly, or sometimes sold to a wholesaler in Phnom Penh as shown in the following figure 7.

**Figure 8: Trade route of incense sticks**



The cross sections of hand-made incense sticks are usually not equal. In addition, the sizes of both ends are usually not equal. Such sticks can be used for hand-made incense production, but cannot be well applied with machine made incenses because the machine contains a mold with a fix size. Incense products

Mr. Buoy Lim, one of the three incense stick traders in Kantuot village, Choam Tamao commune, Memoth district, Tbong Khmum province. He buys incense stick from the primary producers in his village, and stocks at home for sale to incense producers. He bought 130 bundle of incense stick, each of which is 20 kg. Only 60 bundles have been sold so far. He has tried to sell his product to incense manufacturers who produce incenses by machine, but it was not accepted because both ends of the hand-made incense sticks are not equal. He said that I have told to incense stick producers in my village to improve the quality of incense sticks so that it can be well applied with the machine.

have been distributed in many areas such as Suong, Skun, O Raing Ouv, Prek Anchanh, Udong, Siem Reap, Phnom Penh and Ang Tasoam. At present, certain hand-made incense producers have upgraded to machine-made products in order to meet the demand in terms of quantity and quality. Whereas other families who have low financial capital and technology could not upgrade to machine-made products, finally decided to give up this business. The machine-made incenses can be produced in a large volume, has good quality, nice looking and packaging, and has similar price to hand-made incense. At present, the total volume of incense products produced across the country is much lower than the demand, and thus several tones of incenses are imported from Vietnam to Cambodia every month. A wholesaler shop in Phnom Penh reported that his shop imports 5 tons of incense from Vietnam to Phnom Penh every month and distributes it to household-based packagers and markets. It is worth to note that one kilogram of incense stick is capable to produce 3.5 kg of incense. Moreover, this whole seller shop also imports several tons of machine-made incense sticks with round shape from Vietnam to Phnom Penh to supply to machine-made incense producers.

<sup>2</sup> Incense sticks in Keo Seima are made of *B. procera*

Therefore, hand-made incense sticks in Cambodia are not much preferred by machine-made incense producers. Lack of incense stick demand for incense production adversely affects livelihoods of incense stick producers as well as local traders and transport agents in the country. During the study, they reported that incense sticks were produced at many areas in Phnom Penh and Tbong Khmum provinces but some of these production areas have stopped. Three incense producers confirmed that they are able to use 159 tons of incense stick annually for incense production, if they have enough incense sticks, dust of sawn wood and bark of *Litsea glutinosa* (Krapul Bay) to supply for incense production (see table 16 for production capacity of each incense producer). In average, 4 kg of incense sticks can be produced from a culm of *B. bambos*. So, 159 tons of incense sticks need 31,800 bamboo culms (see table 15). The actual demand of incense sticks for incense production can be increased to two to three times if included all production sites and import incenses from Vietnam. With more population increase and economic growth at present and future, more incenses will be used, and so more demand of incense sticks.

Mr. Sait Phat, a small incense manufacturing entrepreneur, is based in Khlaing Praim village, Vaing Chass commune, Udong district, Kampong Speu province. He has 14 incense producing machines, each of which has a capacity to produce 30-40 kg of incense per day. In general, one kilogram of incense sticks can produce 3-4 kilograms of incenses. In average, his factory can produce around 300 kg of incenses, which utilize 100 kg of incense sticks. He uses incense sticks made in Vietnam because it is made by machine, strong and equal size of both ends and well applied with the machine. He said the incense sticks produced by hand are not equal, and thus difficult to produce incense by machine. However, if the hand-made incense sticks are improved and can be produce incense by machine, he is interested to buy because he also wants to buy Khmer products. He can be contacted via his phone number 077 21 21 71.

**Table 15: Annual volume of incense stick demand**

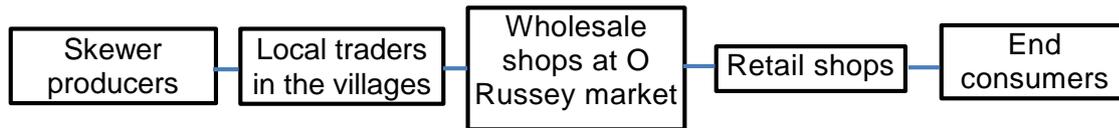
Location	Annual demand of incense sticks
Sangkat Tumnop Toek, Khan Chamkar Mon, Phnom Penh	120 tons
Khlaing Praim village, Vaing Chass commune, Udong district, Kampong Speu province	24 tons
Prek Anchanh,	15 tons

### Skewers

There are three potential local traders located in Koh Pi commune. They buy skewer products from producers in the four villages, and transport to wholesale shops at O Russey market, Phnom Penh. The shops based in Phnom Penh sell these skewers to retail shops in Phnom Penh and other provinces and restaurants. With growth of barbecue restaurants in Cambodia, more beef skewers are needed. However, the demand for local hand-made meat skewers are very low when machine-made products are imported from Vietnam.

Mrs. Chhang Thean is a village trader of skewer product in Koh Pi commune of Tbong Khmum province. She has done this business about 20 years. She said that the hand-made skewers were sold in large volume in the past, but has declined at present. The hand-made skewer products produced by local community in Koh Pi commune cannot be competed with the machine-made skewers imported from Vietnam. She added that the market of hand-made skewers has dramatically declined in 2015. She appeals for government or NGOs to help invent a tool to produce better skewer products, or this processing skill will be disappeared. She is able to contact through her phone 092 92 82 05.

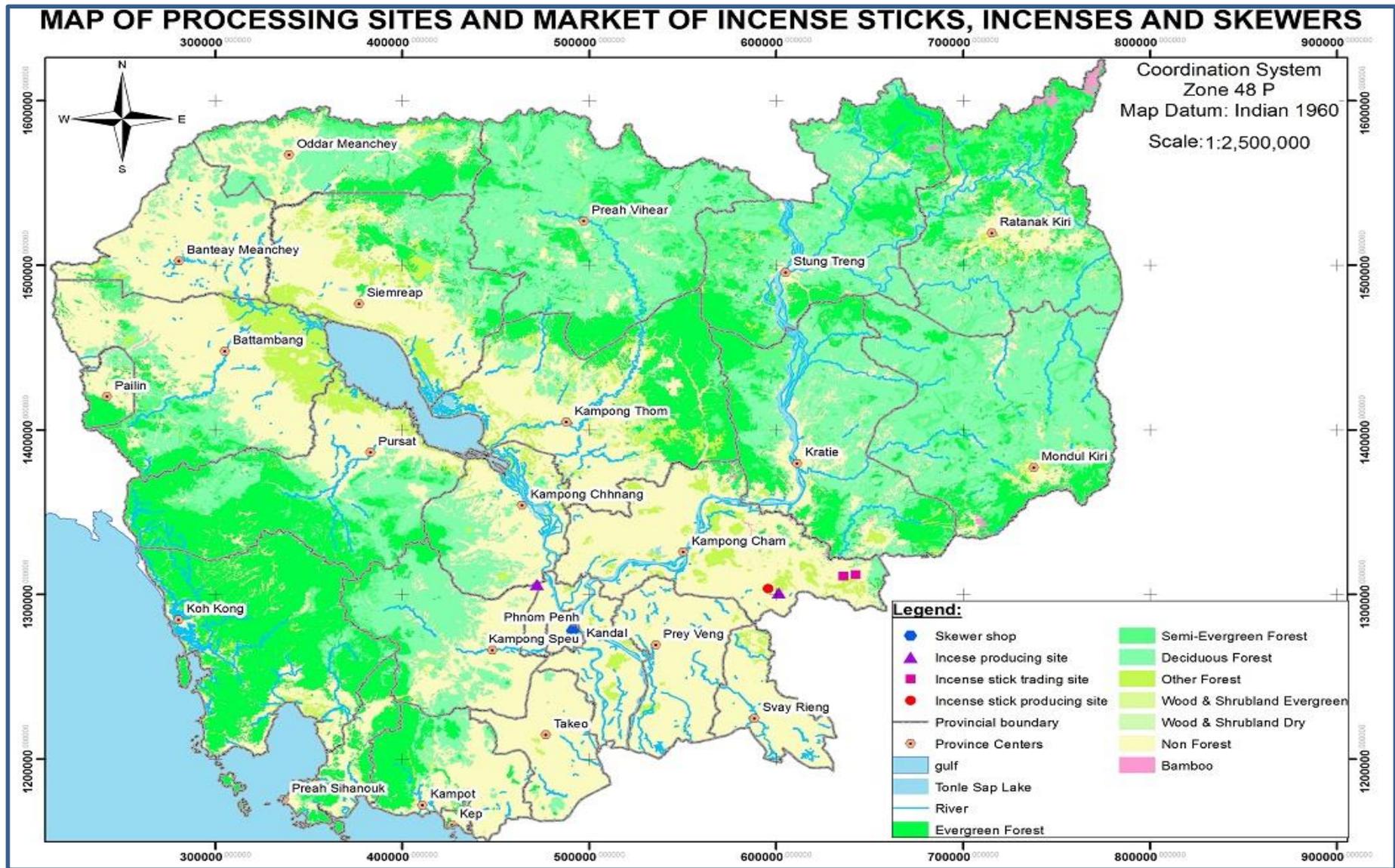
**Figure 9: Trade route of skewers**



#### **5.4.5 Consumers and uses of semi-finished products**

- Bamboo slats are utilized for house construction by many poor households, who cannot afford money to build their houses from wood and concrete. It is also utilized for wall of kiosks. It is now commonly utilized as a frame of concrete foundation in substitute for metal at home yard, parking yards, medium road, etc. Besides, they are utilized for bed floor and fish traps.
- Incense sticks are utilized as a core frame of incense production, and
- Skewers are used for many purposed depending on their sizes. The larger sizes are mainly utilized as a frame of smoked fish production. The medium size is commonly used as a meat skewer which is frequently encountered at the barbecue restaurant.

Figure 9: Map of processing sites and markets of incense sticks, incenses and skewers



## 5.5 Current bamboo trade in final products

Baskets, fish traps and furniture made of bamboos are considered the final product as they are not further processed into any product. However, this study emphasizes on only basket and furniture. Bio char product is also included in this study even though it is now not a significant product for income generation. Basket products are produced by Khmer people, indigenous people and Lao ethnic group of the countries. Baskets are produced in different types, shapes and sizes based on traditional practice, their uses and sometimes market demand. The study of basket products were conducted in five provinces including Kampot, Kampong Chhnang, Svay Rieng, Kampong Thom and Kratie. However, Kampot and Svay Rieng provinces are not included in this report because bamboo species utilized for basket processing is *B. procera* which does not present at the FSB's target sites.

### 5.5.1 Bamboo species and supply sources

Basket products are made of three species including *B. procera*, *B. bambos* and *B. blumeana*. Whereas *T. siamensis* is good for furniture and bed production.

- *B. bambos* is mainly used by indigenous people and Lao ethnic group in the northeastern region, but not so commonly used at the study area. A basket weaver in Kratie province buy culms of this species at a bamboo shop in Krong Kraches. The original supply sources of bamboos to the shops in Krong Kraches are from Da and Changkrang commune of Chetr Borie district, Kratie province.
- *B. blumeana* is cultivated at home yards or farm land within the villages. Basket weavers from Kratie, Kampong Chhnang and Kampong Thom use this species for basket weaving.
- *T. siamensis* is cultivated at home yards and/or farmlands. A furniture in Kampong Thom province buy this species from Baray district of the same province for making furniture.

### 5.5.2 Product types and time

#### ➤ Basket products

There are several types and sizes of basket products produced for sale to local and international markets. However, this study limits to only certain product types and sizes because of that they can represent the other basket products:

- **Kheng or Cheal (Oval basket) in Kratie:** This product type is produced by seven households in Talous village, Bos Leav commune, Chetr Borie district, Kratie province. This basket is mainly made of *B. blumeana* as it is available in this village and nylon for tightening. It consists of many sizes depending on the demand of buyers. However, baskets with size of 60cm x 30cm x 30cm are majorly produced for sale to the Kraches market (see table 16).

**Table 16: Size of oval basket, expenses and price in Talous village**

Size code	Basket sizes (cm)			No of culm per product	Nylon	Production quantity/day	Price per unit product
	Length of bottom part	Height	Width of bottom part				
1	50	30	30	< 1 culm		2 basket/day	12,000
2	60	30	30	1 culm	0.1 kg/3 baskets	2 basket/day	16,000
3	80	30	30	1 culm		1.5 basket/day	20,000
4	100	30	30	1.5 culms		1.5 basket/day	30,000
5	120	30	30	1.5 culms	0.2 kg/3 baskets	1 basket/2 days	50,000
6	140	50	50	1.5 culms		1 basket/2 days	60,000



Basket (Cheal) produced by local community in Talous village, Bosleav commune

In average, each household spends 10 months per year, and 20 days per month for producing baskets. The number of baskets being produced per day are variable depending on skill and capacity of the producers. In average, one day, one household with two members are able to produce two baskets with size of 60m x 30m x 30m. Two culms of *B. blumeana* are able to produce 3 baskets with size of 60m x 30m x 30m. Bamboos are bought from the smallholders in the village at the price of 5,500 riel per culm. At one time, they buy 30 culms, and the transport cost of the 30 culms from the farms to their houses is 25,500 riel per time (see table 17).

**Table 17: Production cost of 3 baskets with size of 60cm x 30cm x 30cm**

Materials	Quantity	Unit cost	Total cost
Bamboo	2 culms	5,500 riel	11,000 riel
Transport cost	2 culms	850 riel	1,700 riel
Nylon	0.1 kg	2,000 riel	2,000 riel
Gasoline for transport to cut bamboo and transport 3 basket products to Kraches market (5 km)	0.5 litre	2,000 riel	2,000 riel
Total			16,700 riel

Based on this production cost and 16,000 riel per one unit product, they can generate income in the amount of 31,300 riel per 3 baskets. So, in average, each household is able to earn income in the amount of 417,333 riel (US\$104 at the exchange rate of 4,000 riel/dollar) per month, or 14,000 riel per day. In average, the seven households of this village use 2,240 bamboo culms per year.

- **Basket products in Kampong Chhnang:** Cheung Kreav commune consists of 11 villages with 1,751 households, all of which involve in producing baskets of different types including round flat basket (Chang-E), deep basket (Kanh Cheu), sieving handle basket (Kantrang Prahok), and sieving round basket (Kanh Chreng). Due to limited time to cover all villages, the study was focused on only a producing group located in Taing Bampong village. This commune also has a processing centre “Cheung Kreav processing centre”, located in Andoung Check village. This centre processes a variety of bamboo products, for instances boxes, flowers, bag, pan, etc.



Basket processing group in Cheung Kreav commune, Kampong Chhnang province

A bamboo culm is 7,000 riel, and can be processed into 6 to 10 baskets depending on the sizes (see table 18). The buyers cut and transport bamboo culms from the farms to their houses by themselves. At one time, they buy 10 culms for processing in one month.

**Table 18: production cost for 6 round flat baskets**

Expense items	Unit	Total cost
Bamboo culms	1 culm	7,000 riel
Transport cost	1 culm	2,000 riel
Fee for tightening frame	6 basket	6,000 riel
Total cost		15,000 riel

For a round flat basket of size 70 cm diameter, a culm of *B. blumeana* can be processed into 6 baskets, and one producer is capable to produce 2 baskets per day. The total cost associated in producing 6 baskets is 15,000 riel (see table 19).

**Table 19: Number of products vs. culms**

Product	Product sizes	No of products /culm	No of products per person/ day	Days / month	Annual production	Farm gate price (riel) at home
Chang E	70 cm	6	2	25 days	baskets	4,000 riel
Chang E	60 cm	10	2	25 days	basket	3,500 riel

With the price of 4,000 riel per basket, a producer can generate income in the amount of 75,000 riel (US\$18.75) per month of the 25 working days.

- **Kanh Chhe (Oval basket) in Kampong Thom:** there are five households in Lvea Chom village, Trapeang Russey commune, Kampong Svay district producing oval baskets. They usually produce a set of oval basket with five respective sizes of 100 cm long, 90 cm long, 80 cm long, 70 cm long and 60 cm long (see table 20). The largest basket size has 30 cm wide and 40 cm high. In average, one household is able to produce 20 baskets per month (see table 21). All basket products are transported by themselves to Kampong Thom market to sell to the shop.

Mr. Huoy Yi is a basket producer in Lvea Chom village. He buys bamboo culms of *B. blumeana* from other villages to produce baskets. The products are sold at the Kampong Thom market. He said that this livelihood does not earn much income, but I can work at home, have freedom and live with my family. He added that I don't need to migrate to other places to search for a job and get risk of it. He also built a charcoal oven to produce charcoal from bamboo waste. This charcoal is used to produce bio char, which is an environmentally friendly fuel product being used for cooking. He also produces furniture for sale, but not quite often due to lack of market interest. He can be contacted through his hand phone 088 91 10 400.

**Table 20: Daily production capacity by products**

Product size (Length)	Product volume	Bamboo/product	Price/culm
100 cm	1 product/day	1 big culm	9,000
90 cm	1 product/day	1 big culm	9,000
80 cm	1.5 products/ day	1 medium culm	7,000
70 cm	1.5 products/day	1 medium culm	5,000
60 cm	5 products/3 days	1 small culm	3,300

**Table 21: Product volume per month and price at the Kampong Thom market**

Product size (Length)	Production volume per month	Unit price sold to Kg Thom market
100 cm	20	35,000
90 cm	20	34,000
80 cm	30	24,000
70 cm	30	19,000
60 cm	33	15,000



Baskets produced by local community in Lvea Chom village, Kampong Thom province



Hand tool machine used by a baskets producer ity in Lvea Chom village, Kampong Thom province

➤ **Furniture product**

There are 13 people of 06 households in Lvea Chom village producing furniture/sofa. They usually produce it on order only. An outstanding family in the village report that his family with two people spends 25 days per month to produce so far in mixing with other works. One set of sofa uses 18 bamboo culms of *T. siamensis* and 10 bolts (see table 22). One set of sofa consists of two small sofas, one large sofa and one table, and sold in the price of US\$120. In average, producing a set of sofa, taken 23 working days, and spent 161,300 riel or US\$40.3 (see table 23).

**Table 22: Materials used for producing one set of sofa**

Products	Number	Size (cm)			Bamboo culms	Bolts	Time spent	Price / unit product
		Length	Width	Height				
Large sofa	2	120	40	38	6	6	10 days	US\$ 40
Small sofa	2	60	40	52	2	4	6 days	US\$ 20
Tea table	1	90	60	60	10	0	7 days	US\$ 50

**Table 23: Production cost for one set of sofa**

Expense items	Number	Unit cost	Total
Bamboo culms	18 culms	4,000 riel	72,000 riel
Bolts	10 pieces	300 riel	3,000 riel
Nail	1 set	1,600 riel	1,600 riel
Insect-anti chemistry, sandpaper, glue	1 set	80,000 riel	80,000 riel
Transport of bamboo culms from farms	1 trip	4,600 riel	4,600 riel
Total			161,200 riel



Sofa product in processed by local community in Lvea Chom village, Kampong Thom province

➤ **Bio Char product**

There is one bio char production site located in Lvea Chom village, Trapeang Russey commune. An oven is constructed to burn the bamboo waste of basket and furniture. The USAID-FINTRAC provided financial and technical supports to a household to construct an oven at cost of US\$1,500. A son of the basket producer was trained to build this oven and now fully capable to do it independently. The bamboo wastes in the amount of 900 kg are burned in the oven and kept it cold for two days. The 900 kg of bamboo waste produce 500 kg of charcoal. Charcoal is processed further into bio char by mixing with termite soil - 7 kg of charcoal mix with 3 kg of termite soil and water. Both charcoal and bio char are ground and mixing together. After well mixed, the power is taken to the mold to make flat shape with hollows in order to stimulate the fire. Bio char is produced for household consumption only. One piece of bio char can cook one time of rice and soup. Bio char product is environmental friendly fuel because it produces less smoke and lacks smell, thus good for barbecue and enclosed kitchen.



Top above is an oven producing bamboo charcoal for bio char production, right side is bio char.

### 5.5.3 Annual production volume

Households who produce bamboo-made products usually spend most of their time on the production. The number of days spent on product processing in different areas vary from 20-30 working days per month, and range from 8 months to one year, depending on whether they cultivate rice or other seasonal crops. The followings are the productions by product types and areas.

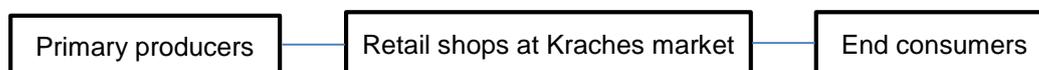
- **Kheng or Cheal (Oval basket) in Kratie:** If taken the basket size of 60cm x 30cm x 30cm as a basis for annual volume production in Bos Leav commune, one household is able to produce 2 baskets per day, and they spend 200 days per year on the basket production. Hence, the total of 2,800 baskets are produced annually by the seven households. The 2,800 baskets consume 1,867 bamboo culms.
- **Basket products in Kampong Chhnang:** Based on the production volume in the account of 50 round flat baskets per month, a producer is able to produce 300 baskets for 6 months per annum, which utilize 50 bamboo culms. So, in average, a producer uses 8.3 bamboo culms per month for basket production. If multiplied with 270 households of this village, the monthly use of bamboos in this village is in the account of 2,441 culms.
- **Kanh Chhe (Oval basket) in Kampong Thom:** Based on average monthly production of one household, five households of the Lvea Chom village produce 240 oval baskets of each size. Hence, 1,200 oval baskets of all sizes are produced.

### 5.5.4 Market and trade routes

The markets for final products are variable by areas. Some villages exist village traders who consolidate products in the villages and transport to the markets, whereas primary producers of other villages sell their products to the market directly. For furniture product, it is produced based on the order by end consumers. The followings are market and trade route of each products.

- **Kheng or Cheal (Oval basket) in Kratie:** Basket producers in the Talous village transport their products to Kraches market by themselves to sell to the retail shops. The distance from their village to the market is around 4 km, and so it is easy for them to access to the market (see figure 10 for market routes and table 24 for value chain). These products are sold to consumers in the province.

**Figure 11: Trade route of oval basket in Kratie**

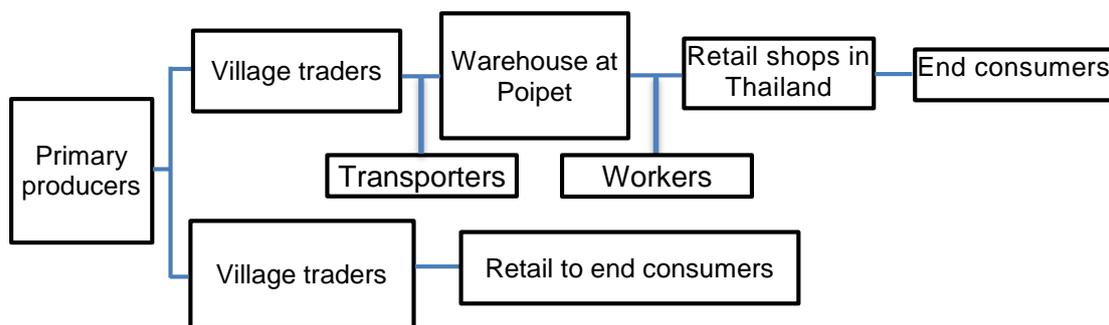


**Table 24: Market chain of basket products from the producing village to end consumers**

Size code	Basket sizes (cm)			Price sold to a retail shop at Kraches market	Price sold at the retail shops to consumers
	Length of bottom part	Height	Width of bottom part		
1	50	30	30	12,000 riel	15,000 riel
2	60	30	30	16,000 riel	20,000 riel
3	80	30	30	20,000 riel	25,000 riel
4	100	30	30	30,000 riel	37,000 riel
5	120	30	30	50,000 riel	58,000 riel
6	140	50	50	60,000 riel	70,000 riel

- **Basket products in Kampong Chhnang:** There are two types of village traders in Cheung Kream commune. One trader buys community products and sell in retail to end consumers in other provinces like Kratie, Stung Treng, Monduliri, Ratanakiri, etc. Mr. So Ren (hand phone 089 42 26 11), a villager trader and also a basket producer, buys 6 types of basket products for sale to northeastern provinces, including Stung Treng, Kratie, Monduliri and Ratanakiri. Each trading trip is spent 20-30 days, and 270,000 riel for transport from his village to Stung Treng province, and 30-40 litre of gasoline for driving motorbike to sell the products. Another village trader, Mrs. Suon Sophoin (hand phone 089 26 14 97), buy community products for sale to Thailand through Poipet border check point (see figure 11 for trade route of the product and table 25 for products' value chain). There is a warehouse at Poipet to stock community products mainly from Siem Reap for rice field rattan-made baskets and from Kampong Chhnang for bamboo-made baskets. Phsa Leu in Thailand side is the big markets that sell basket products originated from Kampong Chhnang and Siem Reap provinces.

**Figure 12: Trade route of baskets of Kampong Chhnang province**



Basket shop at Phsa Leu market, Thailand

**Table 25: Market price of the basket products**

Product types	Product sizes	Farm gate price (riel) at home	Price at Poipet border check point	Price sold at Phsa Leu market, Thailand
Chang E	70 cm	4,000 riel	6,000 riel	100 bath 912,500 riel)
Chang E	60 cm	3,500 riel	5,000 riel	70 bath (8,750 riel)

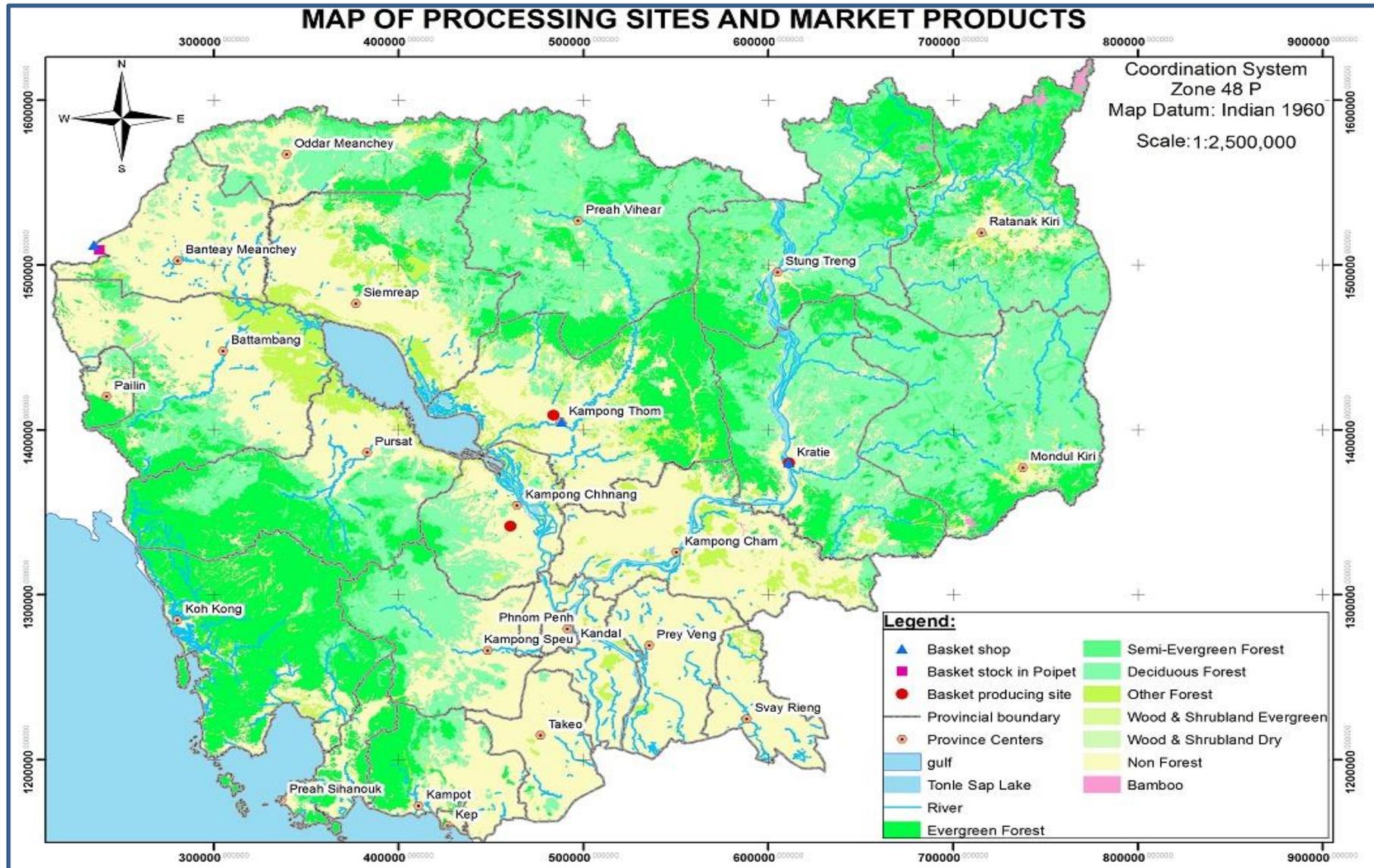
- **Kanh Chhe (Oval basket) in Kampong Thom:** The main market of baskets produced in Lvea Chom village is at Kampong Thom market. Since that Lvea Chom village is around 4-5 km from the Kampong Thom town, the producers transport their products of the five sizes by themselves to the market. The five different sizes of baskets can be inserted together into one set, and allow them to carry up to 18 baskets per one motorbike trip. The price of each basket is variable by sizes as shown in table 26. The Kampong Thom basket market is retail market that sell products to end consumers in the province.

**Figure 12: Trade route of oval basket in Kampong Thom province****Table 26: market of basket products of Kampong Thom province**

Product size (Length)	Unit price sold to Kg Thom market	Unit price sold at the retail shops at Kampong Thom market
100 cm	35,000 riel	40,000 riel
90 cm	34,000 riel	39,000 riel
80 cm	24,000 riel	28,000 riel
70 cm	19,000 riel	23,000 riel
60 cm	15,000 riel	18,000 riel

- **Furniture in Kampong Thom:** Market of bamboo-made furniture product is uncertain because of lack of regular bamboo-made furniture shop in the province. It is produced only when ordered by customers. The producers sometimes get order by end consumers from Phnom Penh, Siem Reap and Kampong Thom province.

Figure 13: Map of processing sites and markets of basket products



## 5.5.5 Consumers and uses of bamboo products

Customers of all products are local people. Even though plastic products dominate at the markets, many Cambodian people both living in the city and rural areas still use bamboo baskets for storing stuffs and drying fish at home. Whereas oval baskets in Kratie and Kampong Thom provinces are used for similar purposes as ones produced in Kampot province but not for rubbish storage. Kampong Chhnang province, baskets are produced for different purposes of rice storage, rice screening, sieving fish paste or coconut milk, drying fishes, etc.

## 6. Discussions

### 6.1. Commercial bamboo species

Based on findings of bamboo market and value chain study, a number of potential bamboo species, which are present at the SFB target sites, are identified in accordance to the use purpose as follows:

- *B. bamboo* and *B. blumeana* can be used to process similar type of products, and so can make a substitution. Though, *B. blumeana* seems to be better than *B. bambos* in terms of longer internode and bigger culm. Both species are good for a number of products, composing of bamboo slat for flooring and frame of concrete foundation; handicraft products; incense stick; skewers, toothpick chopstick, and other souvenir products.
- *T. siamensis* is good for all compositions of furniture products including frame and flooring. Another wild species of *T. oliveri* share the same characters, and so can be substitution. Based on thick culm wall and moderate internodes (25-35 cm long), it seems to be diversified to other potential products like skewer, incense stick, etc.
- *G. albociliata* cannot be processed into any potential product because of short internode, small and not straight culm, except the use of its culm for frame of black pepper shelves.

### 6.2. Value chain of bamboo products and market

#### 6.2.1 *B. bambos* (Russey Roleak)

*B. bambos* is currently processed into two main product types including bamboo slats and incense stick for supply to market. This species is distributed at many areas, but the product processing varies by areas, so this discussion section is flexible by areas.

- **Bamboo slats:** The price of a bamboo culm sold to a bamboo shop at O Russey of Krong Kraches is 1,800 riel, and the bamboo slats processed from a culm of the same size are sold at price of 2,200 riel. So, 400 riel is added value to one culm if it is processed into bamboo slats. There is no either cost or much time requirement in association with this product processing. The bamboo slat processors are usually the primary collectors. They spend half day in the morning to collect bamboo culms and half day in the afternoon to produce bamboo slats. The bamboo slats are mainly used for house construction and fish traps. This product was highly demanded in the past 10 years, but has been remarkably declined in 2004 and 2015. The traders of all the study areas have observed that most of the houses are upgraded to wooden and concrete houses, and so has resulted in the severe decline of bamboo slat demand. Hence, this product type may not be suitable to introduce to the SFB target community area. In addition, there are more challenge in initiating this product type to the community areas as indicate in the followings.
  - The four bamboo resource assessment villages of Boeung Char commune are in long distance from the market, and the transport cost by boat along the Mekong River is expensive. The prime aim of traders who buy bamboos in this commune targets to only bamboo culms so that easy to transport by rafts to depots located in downstream provinces of the Mekong River.

- The two bamboo resource assessment CF/villages located in Preah Rumkel commune seems to be suitable for processing this product type due to good road and bridge link from their villages to the province. However, there is lack of a bamboo depot in Krong Stung Treng. All bamboo slat supply to Stung Treng province comes from Krong Kraches.
- **Incense stick:** Incense stick can be the potential semi-finished product because of high market demand, but processing technique is need to improve both quantity and quality. Based on this findings a number of market aspects are summarized in the followings:
  - All incense producers in Kantuot village collect culm of *B. bambos* by themselves for incense stick processing. Bamboo culms are felled, cut into piece of 33 cm long, split into 4-6 slats, put in the rice sack and transport back home.
  - Based on farm gate in the Kantuot village at the price of 20,000 riel per bundle of 20 kg, the price of one kilogram of incense stick is 1,000 riel.
  - One culm can be processed into 4 kg of incense sticks, and thus 4,000 riel can be earned per day from the processing of one bamboo culm.
  - The incense stick processing doesn't require any capital besides time spent. The time spent for producing incense sticks of one bamboo culm is in average 3.6 hours.
  - The demand of incense stick is increasing in line with the population growth. On the contrary, the sale of local made incense sticks has significantly declined due to that local hand—made product is not in good quality and not well applied with the machine-made incense manufacturing.
  - Cambodia has currently annually imported 650 tons of both incenses and incense sticks from Vietnam for processing incense and packaging in the country (source: incense producers and traders).

### 6.2.2 *Bambusa blumeana* (Russey Srok)

The use of *B. blumeana* is similar to *B. bambos*, but local community at the study areas process this species into basket and skewer products.

- **Basket products:** The profit earned from basket processing is variable by basket types and locations. The followings are a number of provinces where baskets are processed and income is generated:
  - Kratie province, in average, the price of a bamboo culm is 5,500 riel, and one culm is able to be processed into 1.5 baskets. In average, a basket processor is able to produce 1.5 baskets per day. One basket sold at the Kraches market is 11,000 riel, so 1.5 baskets is 16,500 riel. The cost to produce 1.5 basket is 8,350 riel including a bamboo culm, nylon and transport cost. So, net profit generated from producing baskets per one bamboo culm is 8,150 riel.
  - Kampong Chhnang province, a producer takes three day to produce 6 round flat baskets of size 0.7 cm from a culm with price of 7,000 riel. The farm gate price of one basket is 4,000 riel, so 6 baskets are 24,000 riel. The total cost to produce 6 basket is 15,000 riel including expenses on a bamboo culm, transport and framing the baskets. Hence, the net profit generated from the processing of one bamboo culm is 9,000 riel. In average, a processor can earn income in the amount of 3,000 riel for a five hour working day.
  - Kampong Thom province, a processor is able to produce one oval basket of size 100 cm x 30 cm wide and 40 cm height. One basket of this size sold to a basket shop at Kampong Thom market is 35,000 riel. There is no major cost involved in basket production, except for cost of a bamboo culm, so the total expense to produce one basket of this size is 9,000 riel plus 1,000 riel lump sum for transport. So, one producer can generate income in the amount of 25,000 riel per day.
- **Skewer:** A bamboo culm which costs 4,000 riel is able to processed into 13 bundles of meat skewers and 3 large bundles of fish skewers, and generate income in the amount of 10,500

riel. So, income generated from one bamboo culm is 6,500 riel if it is processed into skewers. If three people spending one full day work to process skewers, they can finish one bamboo culm. Hence, each producer can generate income in the amount of about 2,200 riel per day. The market demand of meat skewers has been constantly high, on the contrary, the sale of hand-made skewers has been fallen down in subsequent years, and even seriously declined in 2015. It is because the consumers prefer machine-made skewers imported from Vietnam. There is no accurate figure of imported skewers from Vietnam due to hard to access to traders. Based on the current use of skewers, it can be estimated that at least one ton of skewers are imported from Vietnam to Cambodia every day.

### **6.3 Opportunity and constraint in bamboo enterprise development**

Based on this study, the demand of bamboo slats has ~~been~~ decreased everywhere because of the decrease of fish catches and upgraded most of the houses used to be constructed by bamboos to wood, metal and concrete. The decrease of bamboo slat demand directly affects the demand of raw bamboo culms. Hence, raw bamboo resources at the study areas will face the lack of market. The sign of dramatic decline of bamboo slats has already appeared in 2015, and expected to continue to the following years.

With regard to income generated from basket processing, the highest income from the bamboo processing is in Kampong Thom province, which is capable to earn up to 25,000 riel per day, whereas income earned from basket woven in Kampong Chhnang province is only 3,000 riel per day. A basket processor in Kampong Thom province has a tool to smooth bamboo slat without using hand that can save a lot of time in the production chain. This tool is made in India and provided by Durai who is staff of USAID-FINTRACT. So, all basket processors can increase their production volume if can access to this tool. However, the demand for bamboo baskets have been somewhat declined because there are many substitutions, especially plastic being sold at the market. So, the opportunity to increase basket production in Cambodia seems to be limited.

Skewer processors in Koh Pi commune of Tbong Khmom province could earn only 2,200 riel per day which is the lowest income among bamboo sectors. Whereas incense stick, the processor is able to earn only 4,000 riel per day. In general, these two products are in high demand on the market, but most of the products are imported from Vietnam. At present, the demand of these two types of local products are fallen down because they cannot be competed with imported product from Vietnam in terms of price and quality. Since that incense production is now upgraded from hand made to machine, a large volume of incense stick is demanded to supply to this incense production. So, incense sticks can be a potential product, but the processing technology is needed to improve to enhance both production volume and quality. The processing technology of skewers is also needed in order for local products be competed with import product.

## 7. Conclusion

- Two bamboo species of *B. bambos* and *B. blumeana* can be processed into the same type of products. *B. bambos* has similar size as *B. blumeana* but may cannot be used for baking bamboo sticky rice cake because of absence of papery layer in the interior part.
- *T. siamensis* and *T. oliveri* share the same characters in terms of morphology and culm thickness, so these two species can be processed into the same type of products, like frame of furniture.
- Bamboo culm collection and processing is mainly the secondary livelihoods. The primary collectors operate bamboo collection only when they are free of cultivation and other works and face income shortage. In addition, constructions made of bamboos are for temporary only. At present, many houses in the countryside and town have shifted from bamboos to wood and concrete, which result in low demand of raw bamboo culm and slats on the market.
- The lack of bamboo demand on the market certainly affect the livelihood of local community at the study areas, in particular Boeung Char commune because part of their livelihood activities is bamboo collection for sale.
- Without upgrading bamboo technology, especially skewer and incense stick production, this livelihood activity may face extinction, and people shift to other job opportunity. There have been some signs of negative effect on this product, for instance certain bamboo farms in Koh Pi commune of Tbong Khmum province have been demobilized and replaced by fruit trees, and incense stick processing in Prek Phnov located in Phnom Penh and many villages located in Memoth district have been abandoned. The current incense stick and skewer products made in Vietnam are in high demand at the market, but demand of hand-made products produced by the local community at the study areas is very low because of low quality.
- If simple processing technology is developed and can be accessed by processors, incense stick and meat skewer should be the two promising products for community of the study sites in Boeung Char commune of Kratie province, and Preah Rumkel commune of Stung Treng province
- If introduced high processing technology like machinery to local community, it may not work as well because of low education and less challenge in learning advance technology. The introduction of a simple tool manually operate may be more sustainable and success. For instance, a tool to smooth bamboo slat used by basket processor in Kampong Thom province is compatible to knowledge of the community.
- In order to promote bamboo processing at the study areas, it is needed to ensure that their daily income generated from this livelihood option is 20,000 riel, which is equal or higher than the fee received as daily wage. At present, a person can generate daily income from incense stick and skewer processing in the amount of only 3,900 riel and 3,500 riel respectively.
- Based on this study, *T. siamensis* in Svay Chrum commune of Kampong Chhnang province is very potential for a number of product processing like, chop stick, skewer, toothpick and incense stick. This species has been planted at the study areas of both provinces but still in very small scale. So, should considered to plant this species at these target sites in future.

## 8. Recommendations

On a basis of findings derived from this study, certain bamboo product types are considered potential for enterprise development at the target SFB's project community areas. The followings are type of products and market actors in the value chain process of the target project sites of Kratie and Stung Treng provinces.

### Raw bamboo product

- Stung Treng province does not have any bamboo depot. Therefore, collection of bamboo culms for sale should not be taken into account.
- The enterprise initiative of bamboo culm collection for sale should be considered in the four bamboo resource assessment villages of Kratie province. There can be two options in bamboo enterprise initiative – encourage members of the Community Forestry (CF) in enterprise development, or identify a potential village trader to link bamboo culm products from the villages to the main trader based in Krong Kraches. The potential bamboo trader based in Krong Kraches is Ly Cheu. She can be contacted via her phone number +855 88 45 55 556. Her bamboo depot is located on the Mekong River bank of Thmor Kre commune, and all bamboo culms are transported to Mekong downstream provinces and Phnom Penh capital.
  - Community Based Enterprise Development (CBNE): CF members should be invited to a first one or two day consultative meeting on bamboo culm enterprise in order to identify people who are interested in the bamboo culm trade. This meeting should include the market introduction of bamboo culms, identification of interested members in bamboo enterprise development, their knowledge and experiences in enterprise operation in association with bamboos and/or other NTFPs. The establishment of CBNE is required many processes, meetings, capacity buildings, facilitations, and fund to support a series of events. So, this type of enterprise development needs 5 year project, or even more to help orient them in enterprise operation.
  - Potential village trader: Three villages of Kampong Kbeurng, Koh Ent Chey and Kampong Damrey lack market access of bamboo culms, and thus bamboo-based livelihood activity is very little. Hence, a potential village trader should be identified and encouraged in trade of bamboo culms in order to link bamboo culms from village to the main trader in Krong Kraches. There is a potential person who is currently living in Kampong Damrey village. His name is Kok Veasna, and can be contacted via his phone number +855 88 33 18 887. He used to trade rattan canes of *Calamus rudentum* from around these villages to Sambour town of Kratie province. He should be engaged and encouraged to be a village trader to consolidate bamboo culms of the three villages for sale to the main depot located in Krong Kraches. This type of enterprise option is required less cost and time to facilitate, and so suitable for 1-3 year project. This type of individual enterprise was operated traditionally at many study sites such as Kantuot village of Tbong Khmum province, Sre Roneam village of Kratie province and Kruos village of Kampong Chhnang province, which can be used a model.

In general, it might be hard to see the success in enterprise development when encouraged someone to start new business without technical and capital contributions. Hence, either one of CBNE or individual enterprise should be provided both technical and financial support in order for them to operate their business confidently

### Semi-finished product enterprise

Based on the study, two main semi-finished products of incense sticks and skewers are very potential in the country but currently local made products are not popular in the markets

because of either poor quality or not nice looking. All SFB's target villages in Kratie and Stung Treng provinces should be promoted to produce these two product types. However, the invention of hand tools to produce better product quality is needed in order to compete with imported products from neighboring countries. In order to improve better product quality for market and applicable for the community, two processing tools need to be improved as follows:

- Bamboo sheet splitting tool: a tool to split into bamboo sheets should to be invented in order to split bamboo sheets with equal size, which is required by incense manufacturers. A bamboo sheet splitting tool used by a basket processor in Lvea Chom village, Trapeang Russey commune of Kampong Thom province can be copied and replicated for splitting bamboo sheet in the incense stick and skewer production chain.
- Bamboo sheet shredding tool: a tool to shred into incense sticks needs to be invented and developed in order to process into better quality products and in high volume. Producing a mold to process this product is strongly recommended.

The state owned National Polytechnique Institute of Cambodia ([www.npic.edu.kh](http://www.npic.edu.kh)) should be contacted to invent these tools. If not workable, a number of technical institutions from Vietnam, China, India and the Philippines (Forest Product Research and Development Institute) should be contacted to develop these tools. The SFB Project should consider to invest time and capital on such tool development. If success in technological development, it will provide enormous economic benefit to not only the SFB project sites but also other bamboo processing sites across the country, and also contributes to sustainable management of natural resources in the whole country.

With regard to bamboo-based livelihood development focusing on incense stick product, a number of stages should be considered as follows:

- Vocation training on incense stick production should be delivered to community members at the 6 target villages of the two provinces. A private sector who is experienced in producing incense sticks should be hired to provide vocational training to local community, and help link the community made products to incense producers. Mr. Say Touch, either an incense stick or an incense producer, is a potential person to be hired as a resource person to provide such training service to community. He is currently living in Ponhea Krek district of Tbong Khmum province, and can be reached by his two phone lines - +855 97 37 66 119 and +855 12 65 19 89.
- The sample incense stick product should first be tested to produce incense by machine. The product can be adjusted/improved to be compatible with the machine's mold and satisfied by incense producers.
- A bamboo sheet processing tool used by a basket weaver in Lvea Chom village, Kampong Thom province, should be copied for use in incense stick processing, and innovated incense stick knives that can produce 8-10 sticks should be applied in the target villages. The estimated cost for the two tools is US\$220 including US\$200 for splitting tool, and US\$20 for shredding tool.
- Incense stick producing groups should be organized within the villages, and quality control should be carried out regularly to ensure that products are produced in good quality. The trainer should be engaged in the quality control, and act as a trader to link community product to incense producer. A potential person in the village should also be identified to act as a village trader to link product from these villages to incense producers. There are a number of this practice in Kantuot and Sla villages of Memoth district, and O Toch village of Kampot province. So, exposure study tour may need so as for them understand the process

If bamboo resource is seen potential for livelihood development, its habitat should be managed, and fee of bamboo collection should be set in order to be used for bamboo

management. For bamboo resources located outside CF, commune council and village chief needs to play a crucial role in this management.

**Final product:** Basket processing is not feasible in the four target villages of Kratie province because transport cost by boat along the Mekong River is expensive, which adds high cost to the products. However, basket production in the two target villages of Kroam and Kralapeas, Preah Rumkel commune should be considered because there is currently good road access from the two villages to markets in Stung Treng, Preah Vihear, Siem Reap provinces and Poipet where is bordering to Thailand. The followings are the process in basket enterprise development:

- Organize a meeting with local community to discuss about their livelihoods, existing basket processing skills, their interest in basket processing and need of capacity building in basket processing.
- Planning for vocational training on basket processing to the community. Local basket processors should be identified to provide this training. If not available in the two villages, resource people from other provinces need to be identified. There are two potential processors: 1) Mr. Huoy Yi, a basket processor in Lvea Chom village, Kampong Thom province, can be contacted by his phone number 088 9110 400, and 2) Mr. Sal Saing, a basket processor, in Talous village, Kratie province, can be contacted by his phone number 097 49 28145. The training should be held for 15-30 days dependent on number of basket product types.
- Organize processing groups, and identify potential village traders to link product from the villages to the markets.

**Bio Char production:** An oven to produce charcoal made of bamboo waste should be considered as well because both semi-finished product and final product processing generates a lot of waste, which cannot be used for any purpose. Market of bio char product should be developed in the provincial towns and Phnom Penh in order for producers to generate additional income.

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**Appendix**

**1.1 Datasheet for bamboo market and value chain**

Informant:..... Village:..... Commune:..... District:..... Province:.....

UTM:..... Phone:.....

Product names	Product sizes (length x width x depth)	Culm/unit	Cane/unit	Other raw material	Time spent			# day/product	Day/month	Annual production volume	Market	Price/unit
					Harvest and transport	processing (splitting, smoothing)	Producing					

### 1.2 Market of bamboo products

Name of informant..... Shope: .....Phone: .....

Village:..... Commune:..... District:..... Province:..... UTM:.....

Product names	Bamboo species	Product sizes (length x width x depth)	Product quality	Source of product - Market destination	Bought in price - Sold in price for small quantity	Bought in price - Sold in price for larger quantity	Target buyers	Annual sold volume	market demand

## Annexes

### Annex 1: Locations and actors in bamboo trade

Species	Products	Title	Location	Province	UTM-E	UTM-N
<i>B. bambos</i>	Bamboo forest area	Forest	Village centre	Kratie	607811	1441954
<i>B. bambos</i>	Bamboo forest area	Forest	O Krasang	Kratie	608777	1436093
<i>B. bambos</i>	Bamboo forest area	Forest	O Svay	Kratie	608780	1351858
<i>B. bambos</i>	Bamboo forest area	Forest	Srae O Russey	Kratie	607821	1447983
<i>B. bambos</i>	Bamboo culm	Trader	Thmor Kre depot	Kratie	610807	1388784
<i>B. bambos</i>	Raw poles and slats	Trader, bamboo depot	Chak Angre Kroam	Phnom Penh	494824	1271704
<i>B. bambos, G. albociliata</i>	Bamboo slat and pole	Trader	Depot	Prey Veng	531336	1244673
<i>B. bambos, G. albociliata</i>	Bamboo slat and pole	Trader	Shop, retail	Kandal	501601	1298117
<i>B. blumeana</i>	Basket	Producer	workshop	Kampong Chhnang	460354	1341879
<i>B. blumeana</i>	Handicraft from Kg Chhnang	Trader	Warehouse	Banteay Meanchey	238166	1509324
<i>B. blumeana</i>	Basket from Kg Chhnang	Trader, retail	Phsa Leu	Aranh	235220	1512129
<i>B. blumeana</i>	Basket from Kg Chhnang	Trader, retail	Phsa Leu	Aranh	235203	1512109
<i>B. blumeana</i>	Basket (Cheal)	Producer	Workshop	Kratie	611102	1380066
<i>B. blumeana</i>	Basket	Trader, retail	Kraches market	Kratie	611102	1380066
<i>B. bambos, G. albociliata</i>	Bamboo slat and pole	Trader, retail	O Russey	Kratie	612599	1381298
<i>B. bambos</i>	Bamboo slat	Trader	Village trader's house	Kratie	654727	1358003
<i>B. bambos, G. albociliata</i>	Bamboo slat	Shop, retail	Memoth town	Tbong Khmum	630144	1306540
<i>B. bambos, G. albociliata</i>	Bamboo slat	Shop, retail	Memoth town	Tbong Khmum	629722	1306802
<i>B. blumeana, T. siamensis</i>	Basket, furniture	Producers	House of furniture and craft maker	Kampong Thom	483673	1409056
<i>B. blumeana</i>	Basket	Retail shop	Kg Thom market	Kampong Thom	488150	1404903

<i>B. bambos</i> , <i>B. procera</i>	Incense stick	Trader	Village trader's house	Tbong Khmum	636030	1311338
<i>B. bambos</i> , <i>B. procera</i>	Incense stick	Trader	Village trader's house	Tbong Khmum	642507	1312180
<i>B. bambos</i>	Incense stick	Producer	Workshop	Tbong Khmum	595746	1303585
n/a	Incense	Producer	Udong	Kampong Speu	472130	1306261
n/a	Incense product	Producer	Prek Anchanh	Kandal	601517	1301128
n/a	Incense stick	Producer	Kao Day	Phnom Penh	490195	1276234
n/a	Incense and incense stick	Trader	House	Phnom Penh	490198	1276732
<i>T. siamensis</i>	Ping Ping village	Source	Trapaing Anchanh	Kampong Chhnang	461102	1356964
<i>T. siamensis</i>	Ping Pong shop	Trader, retail	Phsa Kroam	Kampong Chhnang	465550	1356041
<i>B. blumeana</i>	Skewer, basket	Trader, retail	O Russey market	Phnom Penh	491395	1277914
<i>B. blumeana</i>	Skewer	Trader, retail	O Russey market	Phnom Penh	491214	1277994

#### Annex 2: Study areas and key contact actors in bamboo products and markets

No	Product category	Interviewee name	Contact Phone	Address	Role
1	Bamboo culm	Oek Sok	060728287	Trea Cheung village, Sre Thmey commune, Rolea Ba-ear district, Kampong Chhnang province.	Bamboo culm middleman
2	Bamboo culm	Khou Kheng	089 20 20 92	Trapaing Anchanh village, Svay Chrum commune, Rolea Ba-ear district, Kampong Chhnang province	Bamboo owner
3	Bamboo culm/ slat	Nai Son	092 67 27 51 /097 66 44 844	Sangkom Meanchey Thmey village, Tromoung commune, Memoth district, Tbong Khmum province	Bamboo retailer
4	Bamboo culm/ slat	Huy Sy	097 94 35 725	Sangkom Meanchey Thmey village, Tromoung commune, Memoth district, Tbong Khmum province	Bamboo retailer

5	Bamboo culm/ slat	Sok Kheang	092 20 65 09	Masin Toek village, Tromoung commune, Memoth district, Tbong Khmum province	Bamboo retailer
6	Bamboo culm/ slat	Pich Sopheap	011 71 52 97	O Russey village, Sangkat O Russey, Krong Kratie, Kratie province	Bamboo retailer
7	Bamboo culm	Uk Sam Art	012 689724	Chong Koh village, Sangkat Phsa Chhnang, Krong Kampong Chhnang, Kampong Chhnang province	Bamboo retailer
8	Bamboo culm/ slat	Hait Eng Lun	092 30 88 80 / 012 77 44 51	Prek Tamaik village, Prek Tamaik commune, Khsach Kandal district, Kandal province	Bamboo retailer
9	Bamboo culm/ slat	Na Ron	017 87 13 13	Chak Angre Kroam village, Sangkat Chak Angre Kroam, Khan Mean Chey, Phnom Penh	Bamboo trader wholesaler-retailer
10	Bamboo culm/ slat	Sok Ki	012 68 87 38 / 012 92 02 25	Chak Angre Kroam village, Sangkat Chak Angre Kroam, Khan Mean Chey, Phnom Penh	Bamboo trader_ wholesaler-retailer
11	Bamboo culm	Ly Cheu	088 45 55 556	Thmor Kre village, Thmor Kre commune, Krong Kratie, Kratie province	Bamboo trader-wholesaler
12	Bamboo culm	Chem Chhan	088 5379782	Anchanh village, Dar commune, Chetr Borie district, Kratie province	Primary collector
13	Bamboo culm	Soeng Sim	097 77 40 764	Sre Roneam village, Khsoem commune, Snuol district, Kratie province	Primary collector
14	Bamboo culm	Ek Than	097 83 31 963	O Krasang village, Boeng Char commune, Sambour district, Kratie province	Small holder
15	Bamboo culm/slat	Mae Pich	097 49 45 781	Sre Roneam village, Khsoem commune, Snuol district, Kratie province	Bamboo village trader
16	Basket	Sann Vann Sen	088 77 94 665	Koh Ent Chey village, Boeng Char commune, Sambour district, Kratie province	Basket producer
17	Basket	Huoy Yi	088 91 10 400	Lvea Chom village, Trapeang Russey commune, Kampong Svay district, Kampong Thom province	Basket producer

18	Basket	Touch Ten	0719917491	Talous village, Bos Leav commune, Chetr Borie district, Kratie province	Basket producer
19	Basket	Sal Saing	097 49 28145	Talous village, Bos Leav commune, Chetr Borie district, Kratie province	Basket producer
20	Basket	So Ren	089 42 26 11	Taing Bampong village, Kruos commune, Rolea Pa-ear district, Kampong Chhnang province	Basket producer
21	Basket	Nhan Thet	012 64 56 12	Taing Bampong village, Kruos commune, Rolea Pa-ear district, Kampong Chhnang province	Basket producer
22	Basket	Treung Heang	092 63 12 88 / 097 55 59 533	Watt village, Sangkat Kraches, Krong Kraches, Kratie province	Basket retailer
23	Basket	Mrs. Ley	077 87 38 73	Sangkat Phsa Kandal, Krong Poipet, Banteay Meanchey province	Basket retailer
24	Basket	Ly Hour	0978298114	Kampong Thom market, Sangkat Kampong Thom, Krong Kampong Thom, Kampong Thom province	Basket retailer
25	Basket	Tem Sophal	012213891	Kampong Thom market, Sangkat Kampong Thom, Krong Kampong Thom, Kampong Thom province	Basket retailer
26	Basket	Suon Sophoin	089 26 14 97	Taing Bampong village, Kruos commune, Rolea Pa-ear district, Kampong Chhnang province	Village basket trader
27	Basket	Chea Song Heang	077 66 87 66 / 070 66 87 66	Mung Chin village, Sangkat Phsa Kandal, Krong Poipet, Banteay Meanchey province	Warehouse owner
28	Incense	Sat Phat	077 21 21 71	Khlaing Praim village, Vaing Chass commune, Udong district, Kampong Speu province	Incense producer
29	Incense	Tong Heng	012 38 81 77	Kroam village, Prek anchanh commune, Mok Kampol district, Kandal province	Incense producer

30	Incense	Ven Chhinla	092 48 97 27	Preah Prasorb village, Preah Prasorb commune, Khsach Kandal district, Kandal province	Incense retailer
31	Incense stick	Chheun Ravy	097 90 17 824	Kantuot village, Choam Tamao commune, Memoth district, Tbong Khmum province	Incense stick producer
32	Incense stick	Boay Lim	097 90 17 824	Kantuot village, Choam Tamao commune, Memoth district, Tbong Khmum province	Incense stick wholesaler
33	Incense stick	Seng Maip	097 79 28 826	Sla village, Troloung commune, Memoth district, Tbong Khmum province	Incense stick wholesaler
34	Incense stick/incense	Say Touch	017 65 19 89 / 097 37 66 119	Po Srok village, Koang Kang commune, Ponhea Krek district, Tbong Khmum province	Incense (stick) producer
35	Incense stick/incense	Loem Ty	012 97 76 22 / 012 88 66 22	Sangkat Tomnob Toek, Khan Chamkar Mon, Phnom Penh capital	Incense (stick) wholesaler
36	Incense stick/incense	Mr. Heang	078 58 88 17	Sangkat Tuol Svay Prey 3, Khan Chamkar Mon, Phnom Penh capital	Incense wholesaler
37	Incense stick/skewer	Meng Hy	092 68 26 82 / 012878444	Bak Kheng village, Sangkat Prek Leap, Khan Chroy Changva, Phnom Penh capital	Incense stick processr (also include skewer and chop stick)
38	Skewer	Vaing Chan	012 41 03 24	Bei Pey village, Koh Pi commune, Tbong Khmum district, Tbong Khmum province	Skewer producer
39	Skewer	Ly Yong Meng	011 61 55 40	Sangkat O Russey, Khan 7 Makara, Phnom Penh capital	Skewer retailer
40	Skewer	Chhang Thean	092 92 82 05	Bei Pey village, Koh Pi commune, Tbong Khmum district, Tbong Khmum province	Skewer wholesaler
41	Skewer	Trader 1	015 94 18 55	O Reussey market, Sangkat O Russey, Khan 7 Makara, Phnom Penh capital	Skewer vendor
42	Skewer	Vang Simey	012 25 96 52	O Reussey market, Sangkat O Russey, Khan 7 Makara, Phnom Penh capital	Skewer vendor
43	Skewer	Malish	012 79 21 85 / 012 9443 40	O Reussey market, Sangkat O Russey, Khan 7 Makara, Phnom Penh capital	Skewer vendor

44	Skewer	Vong Lany	099 64 63 61 / 088 94 26 937	O Reussey market, Sangkat O Russey, Khan 7 Makara, Phnom Penh capital	Skewer vendor
45	Skewer	Yeay Sloek Chhouk	011 66 55 40	O Reussey market, Sangkat O Russey, Khan 7 Makara, Phnom Penh capital	Skewer vendor